The Health Exhibition literature / International Health Exhibition, London, 1884.

Contributors

International Health Exhibition (1884 : London, England)
Royal College of Physicians of Edinburgh

Publication/Creation

London : printed and published for the Executive Council of the International Health Exhibition and for the Council of the Society of Arts by William Clowes, 1884.

Persistent URL

https://wellcomecollection.org/works/k3pfzck4

Provider

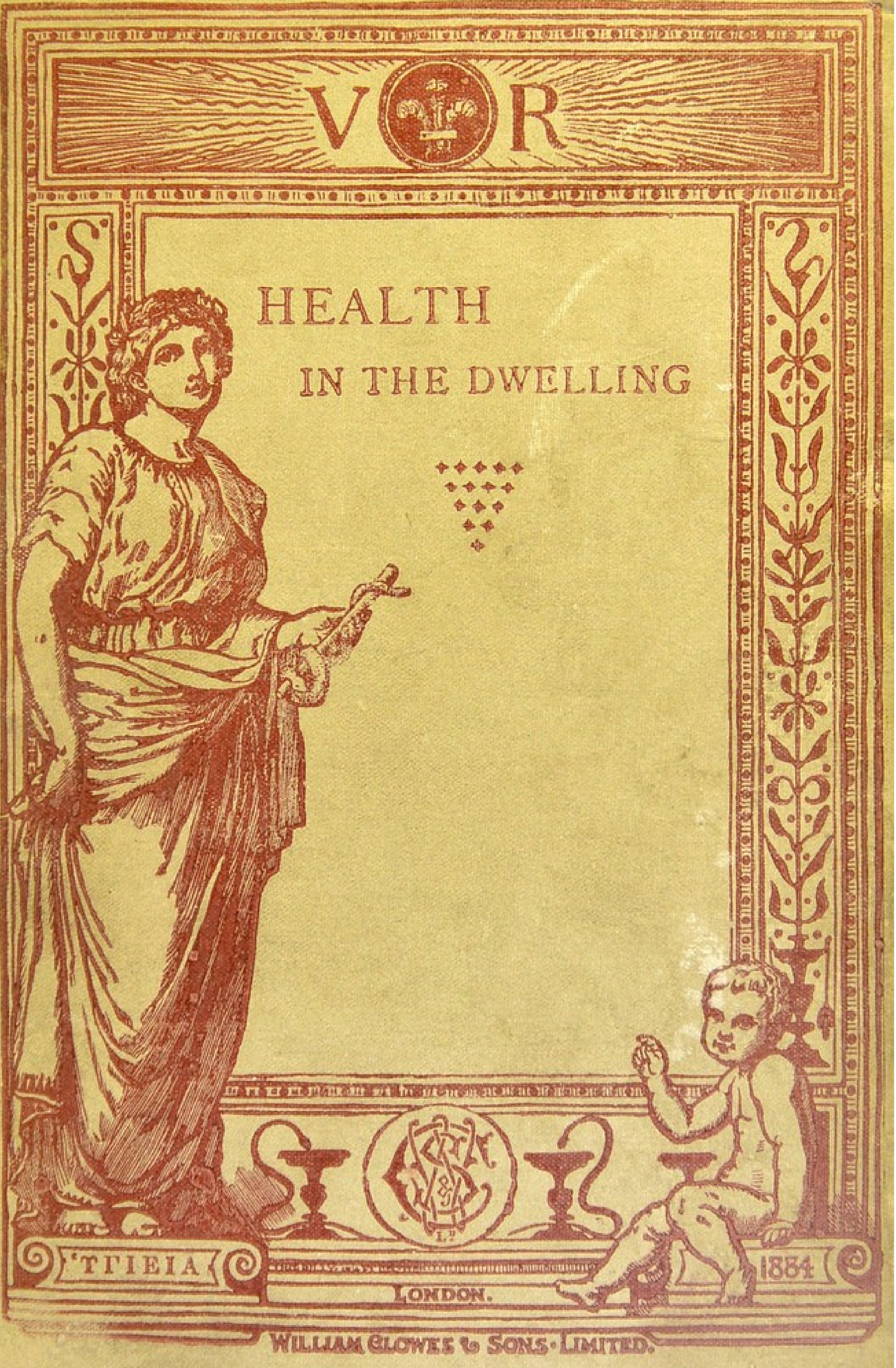
Royal College of Physicians Edinburgh

License and attribution

This material has been provided by the Royal College of Physicians of Edinburgh. The original may be consulted at the Royal College of Physicians of Edinburgh.
This work has been identified as being free of known restrictions under copyright law, including all related and neighbouring rights and is being made available under the Creative Commons, Public Domain Mark.

You can copy, modify, distribute and perform the work, even for commercial purposes, without asking permission.

Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
https://wellcomecollection.org



V R

HEALTH
IN THE DWELLING

'ΥΓΙΕΙΑ

1884

LONDON.

WILLIAM CLOWES & SONS · LIMITED.

Fcb. 21

R51366

MACLACHLAN
&
STEWART
64
SOUTH BRIDGE
EDINBURGH
Est. [illegible]

International Health Exhibition,
LONDON, 1884.

THE

HEALTH EXHIBITION LITERATURE.

ROYAL COLLEGE OF PHYSICIANS. EDINR.
LIBRARY

VOLUME I.

HEALTH IN THE DWELLING.

HANDBOOKS.

HEALTH IN THE VILLAGE.
HEALTHY NURSERIES AND BEDROOMS, INCLUDING THE LYING-IN ROOM.
HEALTHY AND UNHEALTHY HOUSES IN TOWN AND COUNTRY.
HEALTHY FURNITURE AND DECORATION.
HEALTHY SCHOOLS.
HEALTH IN THE WORKSHOP.
ON VENTILATION, WARMING AND LIGHTING FOR DOMESTIC USE.

PRINTED AND PUBLISHED FOR THE
Executive Council of the International Health Exhibition,
and for the Council of the Society of Arts,
BY
WILLIAM CLOWES AND SONS, LIMITED,
INTERNATIONAL HEALTH EXHIBITION,
AND 13, CHARING CROSS, S.W.
1884.

LONDON :
PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
STAMFORD STREET AND CHARING CROSS.

HANDBOOKS.

PAGE

HEALTH IN THE VILLAGE. By SIR HENRY W. ACLAND, K.C.B., F.R.S., etc. 1

HEALTHY NURSERIES AND BEDROOMS, INCLUDING THE LYING-IN ROOM. By MRS. GLADSTONE 95

HEALTHY AND UNHEALTHY HOUSES IN TOWN AND COUNTRY. By WILLIAM EASSIE, C.E., F.L.S., F.G.S., etc. With an Appendix on the Water Supply and Disposal of Sewage of Country Houses. By ROGERS FIELD, B.A., M. Inst. C.E. . 149

HEALTHY FURNITURE AND DECORATION. By ROBERT W. EDIS, F.S.A., Architect 287

HEALTHY SCHOOLS. By CHARLES E. PAGET 367

HEALTH IN THE WORKSHOP. By JAMES B. LAKEMAN . . 441

ON VENTILATION, WARMING, AND LIGHTING FOR DOMESTIC USE. By CAPTAIN DOUGLAS GALTON, C.B., D.C.L., F.R.S. 547

Digitized by the Internet Archive
in 2015

https://archive.org/details/b21908333_0001

PREFACE.

THE International Health Exhibition constitutes an epoch in Popular Education. It promises to impress on many thousands of the middle and hard-working classes ideas which are of first-rate importance to them. Of these but three need be here specially named.

1. The value of Scientific teaching in matters affecting health, though often seemingly unconnected therewith.

2. The relation of true Education to the material condition of the homes and the workplace.

3. The value to the dwellers in great towns of rational out-of-door Recreation at a cheap rate and without excitement.

These ideas certainly are not new; but the Exhibition will indelibly impress them for the first time on multitudes. It has been sometimes objected, both in public and in private, that there is no reason why this Exhibition should be called a Health Exhibition, for that it is but a form of World Fair. If it be so, it is a World Fair resting on the solid foundation of Scientific Knowledge practically applied, and good for instructed and uninstructed alike. No doubt, many exhibits taken by themselves have not an obvious connection with the maintenance of Health, or with the Prevention of Disease; but individual exhibits are not to be taken alone. They are part of a great series illustrating, though partially, the innumerable existing conditions which directly affect the mental and bodily health of man. They all tend to show what philosophers and moralists from Aristotle onwards have clamoured to impress on us, the importance of attention to the formation of habits in every direction, and of attention to the smallest particulars, if we are to make, or be made, the best in body or in mind. One of the wisest and most clear-sighted men that this country has produced in our day, an honour alike to the army, to medicine and the nation, Edmund Parkes, says: "We must not venture to arraign Providence for loss of health, and for all the evils to us and others which follow it, until we are sure that the root of the matter is not in ourselves. Those who have most studied the causes of disease are most convinced that in the neglect of very obvious rules of morality and common sense the secret origin of many diseases lies, and that if he will, it is in the power of man himself to erase from the world a large portion of those sufferings, the sight of which weighs so heavily on our minds." *

Now the Handbooks published by the Executive Committee well illustrate the statements made above. They are contained in four volumes. Each paper takes some one point bearing on Health. The *first* volume treats chiefly of Dwellings; the *second*, of Food; the *third*, of several Health questions depending on Chemistry, and the Public Health; while the *fourth* deals with Recreation, Injuries, and of other risks to life, together with an essay also on Water Supply.

The mere enumeration of the subjects contained in the thirty treatises comprised in these volumes suggests at once the vast and varied interests which are engaged in the preservation of health. But it does yet more: it cannot but recall how many subjects there are which are not even touched upon by the extended and multifarious collection which the Handbooks attempt practically to explain. The series of "*Conferences*" do this also. They draw attention to the varied mass of scientific knowledge which in every direction is maturing the fruit of practical results, directly useful to the health of man.

On the seven treatises in the present volume a few words only need be said. They are intended either to awaken interest in certain selected topics appertaining to Health, or to give a popular account of some in which all are concerned. The general management of the rooms for our children, and of the sick room, is treated of by Mrs. Gladstone. The arrangements which make houses, whether in town or in country, safe or unsafe in their sanitary aspects, are discussed by Mr. Eassie and Mr. Rogers Field. These general health conditions of isolated houses are shown in their simplest form of aggregation in our country villages. The healthiness of our schools, bringing at once the whole subject of Education in its relation to Health, is treated by Mr. Charles Paget; and the requirements and laws of our workshops are stated by Mr. Lakeman, the Senior Metropolitan Inspector of Factories. All these may well give to any who are not fully informed, no small interest in their respective subjects. Mr. Edis discourses on Furniture and Decoration, and Captain Douglas Galton handles topics of so great importance in our climate, whether in the palace, the cottage, the alley, or the town—topics to which he has given so long attention—viz., Heating, Lighting, and Ventilation.

---

* 'Personal Cares of Health,' by E. A. Parkes, M.D., F.R.S., p. 3.

To analyse or describe these treatises would of course here be unnecessary. Only one remark is added on the whole subject of this effort by the Prince of Wales and his able coadjutors to popularise what is known of sanitary principles, and thus to increase the popular interest in their progress. It must be always borne in mind that the knowledge of Arts and Sciences advances along two lines—the empirical and the scientific; in some the one, in some the other, method takes precedence in the history of any subject-matter. The modes of living may be said to have been in all countries at first empirical. Gradually as population increased in each, they are regulated for the common convenience so as to proceed towards established customs and then to laws. In the later stage they become objects of rigorous inquiry and scientific analysis. Then come severely tested statements and principles, constituting the Science of the subject. The progress which has been made within the memory of this generation in all the arts which affect Health is such as the world has never before witnessed. It depends mainly on the growth of Chemical, Physical, and Biological (Physiological, Pathological and Therapeutical) observation and research, and on Statistical inquiries. It may be well traced in the History of Foods, of Agriculture, of Dwellings, of Occupations, of Education, of Recreation, and of Sociology. The vast and heterogenous mass of information in these and other directions affecting Health, Personal and Public, almost defies, at present, classification.

But from this mass, data for a science of *Comparative National Health* are surely accumulating, and will in time throw light on various problems of the Human Race. May the efforts of those who have endeavoured through the means laid open by this Exhibition, produce the effect they seem to desire—*the Education of the people in the science of preserving* their own and the *National Health.* And so may the robust character, whether in body and mind, of our generation be, under growing difficulties of excessive population, fostered and increased, and may the sound experience here gained be laid open, as all scientific knowledge is ever laid open, for the equal good of all the Nations of the Earth.

H. W. A.

HEALTH IN THE VILLAGE.

BY

Sir HENRY W. ACLAND, K.C.B., F.R.S.,

Regius Professor of Medicine in the University of Oxford;
Honorary Physician to H.R.H. the Prince of Wales;
President of the General Medical Council; Hon. LL.D. Cambridge, Edinburgh, Durham; Hon. M.D. Trin. Coll. Dublin, &c.

Σοφία καὶ ἐπιστήμη καὶ εὐσέβεια πρὸς τὸν Κύριον, οὗτοι εἰσι θησαυροὶ δικαιοσύνης.

"Wisdom and knowledge shall be the stability of thy times."

PREFACE.

THE object of this Paper is twofold :—

1st. To sketch certain conditions of village life that are clearly unfavourable to health and to well-doing ; and at the same time to show that observers sometimes attempt to assign too precise limits to the conditions requisite for Village health.

2nd. To present to the general reader a broad view of the circumstances most favourable to the good order and happiness of a rural population.

The mass of information on these questions is so great, the instances that might be given so numerous, and the choice of illustration so wide, that these few pages seem to the writer wholly inadequate to treat so large a subject. He throws himself therefore on the mercy of the reader.

Still he hopes that the instances given are fairly typical and suggestive. Space will not allow him to make here any detailed acknowledgments to the great sanitary teachers of our time, such as Farr, Parkes, Christison, Stokes, Sidney Herbert, Shaftesbury, Simon, Chadwick, Rawlinson, Galton, Pettenkofer, Michel Levy, Morin, Bowditch, Waring, or Billings. For forty years he, as many others, has been under deep debt to them and their colleagues in this and other countries for unwearied scientific and philanthropic work. Nor can he forget what the world owes to Miss Nightingale, and now England to Miss Octavia Hill.

The writer desires to record his hearty thanks to several who have assisted him in this seemingly trivial task. Especially he thanks all who have furnished him with plans of cottages and information about them ; His Royal

Highness the Prince of Wales, His Grace the Duke of Northumberland, His Grace the Duke of Bedford, the Earl of Rosebery, His Excellency the Earl Spencer (for permission to describe his village of Chapel Brampton), the Office of the Ecclesiastical Commissioners, Messrs. Clutton and their Architect, Mr. Beauchamp, The Honourable C. A. Gore of H.M. Woods and Forests, his brother Sir Thomas Dyke Acland (among whose labourers he has passed from childhood some of his most instructive and happiest hours in the Hill Country of the West), to Mr. Harbottle, Architect, of Exeter, to Mr. Robert Castle, of Oxford, and Mr. Field, for their plans and advice, for years past, in the little parish of Marsh Gibbon, to his co-trustees there, to Mr. E. F. Griffith, the Civil Engineer, who gave the designs of the Chapel Brampton drainage and water-supply; and lastly, to Mr. Collings, for his patience and skill in hurriedly preparing all the delicate woodcuts from sometimes very rude material.

Oxford, May, 1884.

CONTENTS.

I.—THE TALE TOLD.

PAGE
Sketch of Lowmarsh—an English Village in the pre-Sanitation Period 7
Various Health Conditions in the ruder kind of Villages, *e.g.*, St. Kilda and Donegal, and among the tents of the Bedouins (North Africa) and Micmac Indians (Nova Scotia), with general conclusions thereon 20

II.—THE NEED STATED.

General Requirements for Healthy Village Life . 29
  The Dwellings 30
  The Water-supply 39
  The Removal of Refuse 42
  Education, Occupation, and Recreation . . 50
  Care in Sickness 60

III.—THE LESSON LEARNT.

Illustrations from various Parts of England . . 63
Progress 80
The End, or Lowmarsh revisited 84

IV.

Introductory Books. 90
Registers of Cottages 91

ILLUSTRATIONS.

PAGE
1. THE COLLEGE 10
2. THE BEDRIDDEN SISTER 11
3. THE TECHNICAL SCHOOLROOM 14
4. INTERIOR OF THE SCHOOL 14
5. MAP OF THE PARISH OF MARSH GIBBON . . . 16
6. LAND-MARKS 17
7. WIGWAM UNIT OF AN INDIAN VILLAGE, 1860 . . 21
8. BEDOUIN TENTS NEAR CARTHAGE, 1838 21
9. THE VILLAGE OF ST. KILDA IN 1834 22
10. WEAVER'S HOME IN DONEGAL (BY LIONEL MUIRHEAD, 1881) 23
11–19. STANDARD LABOURER'S COTTAGE (MARSH GIBBON) . 33
20–27. COTTAGE, NO. 2 36
28. COTTAGE, NO. 3 (SIR THOMAS DYKE ACLAND) . . 37
29–30. OCCASIONAL COTTAGE, CHADWICK AND NICOLL . 38
31–36. ASH OR EARTH COTTAGE CLOSETS USED IN SOMERSET AND DEVON, (MR. NEVILLE GRENVILLE AND SIR THOMAS DYKE ACLAND) 43
37. PLAN SHOWING THE DRAINAGE AND WATER-SUPPLY OF CHAPEL BRAMPTON, NORTHAMPTONSHIRE 44
38. DRAINAGE OF BLOCK PLAN OF FIVE COTTAGES . . 46
39. METHOD OF DISCONNECTING HOUSE DRAIN FROM SEWER 47
40. DISCONNECTION OF SINK 47
41–43. PLAN AND SECTIONS OF FLUSH TANK 48
44. CLOSET 49
45. PLAN OF A COTTAGE AT SANDRINGHAM 65
46. DO. DO. DO. 65
47, 48. DUKE OF NORTHUMBERLAND'S ONE-FLOOR COTTAGES 70
49–51. DO. DO. TWO-STOREY DO. 71
52. ECCLESIASTICAL COMMISSIONERS' COTTAGE . . . 72

I. THE TALE TOLD.

1. SKETCH OF LOW MARSH, AN ENGLISH VILLAGE IN THE PRE-SANITATION PERIOD.

ON a sultry evening in the summer of 1858, I was sitting on a grassy knoll, looking over a flat and broad expanse in a midland county of England. A delicate outline of hills, not wholly unlike that of the Alban mount which bounds the Campagna of Rome, could just be seen some miles away through the heated haze that rose from the surface of the plain.

Dividing the level lands were rare hedgerows and rarer trees. No sounds were to be heard save the nibbling of stunted grass by some ill-fed sheep, and the continuous hum of countless insect life so uncommon here, so common in some other lands. As I stayed gazing on this not extraordinary scene (for in country life there is always a rich field for reflection), suddenly there rose, from below a mile away, the pleasing murmur of village bells. Then distant, and yet more distant, peals took up the melody, in churchyards far beyond. Peering through the hot and wavy air I saw first one church tower half hidden among clustered trees and then another; but though several vesper bells were heard I could see through the mist no other sacred edifices. As I slowly descended the green and slippery slope, the music of ever remembered words seemed to chant in unison within me :—

Dear lovely bowers of innocence and ease,
Seats of my youth, where every sport would please ;
How often have I loitered o'er thy green,
Where humble happiness endear'd each scene !

How often have I paus'd on every charm,
The shelter'd cot, the cultivated farm,
The never-failing brook, the busy mill,
The decent church that topt the neighbouring hill,
The hawthorn bush, with seats beneath the shade,
For talking age and whispering lovers made!

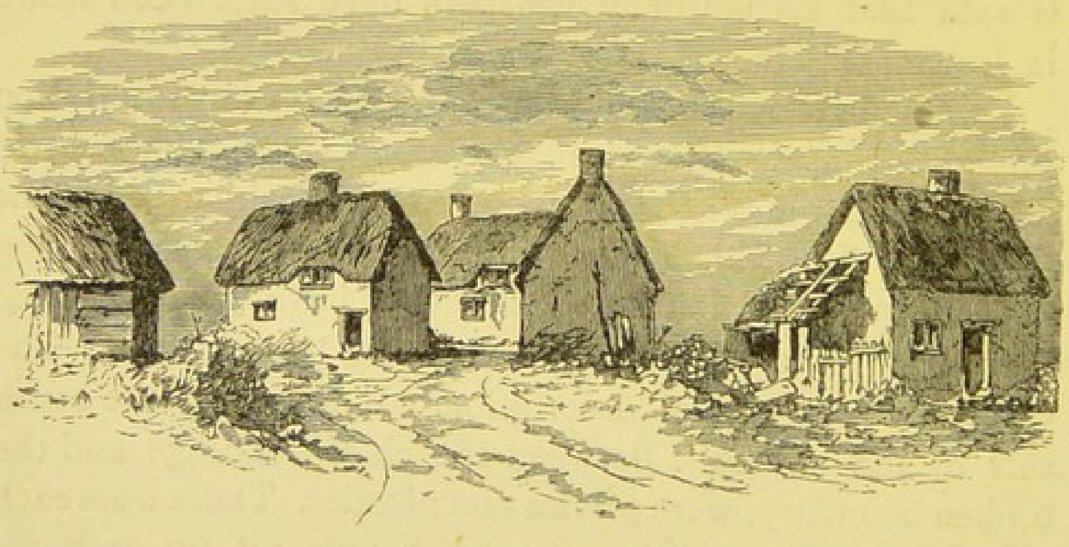
I entered a straight, rough parish road, bounded on either side by a grassy border some twenty feet wide, and by treeless hedges beyond. Soon I came to a spot where the way divided into two. At the angle stood a spare wiry man, past the prime of life. He seemed to be a yeoman. To judge by the twinkle of his grey eye, his intelligence was above the common run. "Which is the way to Lowmarsh?" I said. "Well," he answered, "you can go which way you please. This way (pointing south) will take you to the 'Bulldog.' This one (pointing eastward), to the Church and School." "Which is the best road?" I said. "You can decide that for yourself," he replied; "and if you don't like to go either way, you can stop here." He was then leaning against a low wall. It was the boundary of a prim plaster-fronted Chapel. At this moment a hymn, sung lustily, arose within. On this, he, saying nothing, briskly went away along the eastern road. I stood for a minute listening and musing what he should mean. "The 'Bulldog,'" he said, "or the Church and School, whichever you please, or stop here." Then I chose the way by which he had gone, towards the Church and the School. But he was out of sight.

Before I reached the church I passed a half-ruined cottage; in front of it lay a brown and stagnant pool. The cottage had been of the better kind. It had an old carved door; the panels of which, with the solid oaken styles, formed a broad, deeply moulded cross. A post-office and the house of the village grocer were opposite. Then I passed the workshop of a wheelwright. The doors of this were formed as barn-doors, closed to-day, being Sunday, but, as I learnt afterwards, on week days thrown open wide for daylight and free air as he worked at his laborious and skilful occupation. He is maker of the heavy waggons and lighter tax-carts for the district of the Marsh.

Now I was near the churchyard and the church. But first I passed a grey old manor house of the Elizabethan kind. There was a little garden in front with a grass plot unshorn. There were drooping fuchsias in the corners; wall-flowers generally wandered about unweeded beds. Ivy alone seemed triumphant here. I could now hear, through the open doors, chanted in measured cadence, the words, "Lord, now lettest thou thy servant depart in peace." I did not then enter the church, lest, being a stranger, I should disturb the congregation. I might perhaps have brought on me the rebuke, which, as I learnt afterwards from my friend with the grey eyes, the churchwarden had poured down on a devoted couple, heard whispering in the corner. "Mr. Woods," said he, rising after the second lesson, and addressing the Vicar slowly and distinctly, "Will you stop a bit, if you please? Bessy Jones and John Thorn have something to say to each other. One at a time, if you please, during church, Mr. Woods." It is said that no untimely whispers have since been heard in Lowmarsh church.

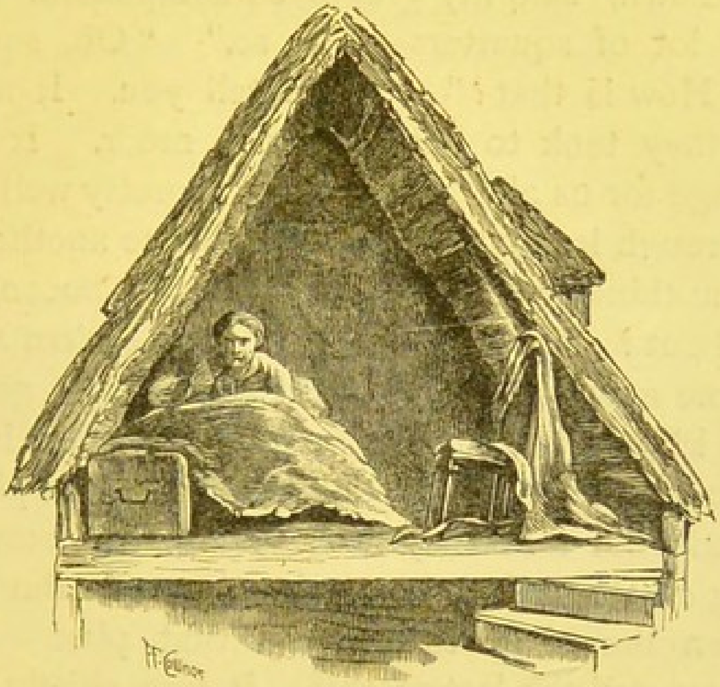
I walked through the churchyard. Scarce any inscription caught my eye. Literature had not as yet flourished in Marsh-by-the-Moor, though close to the churchyard was "the College." Into this institution I found my way, stepping over the ruins of a low wall that would have parted it from the burial-ground had not it, the wall, been in ruin. The College needs special description. It stood on the south side of the church. Between the chief buildings and the broken boundary, were privies and pigsties. These were each constructed of grey lichen-covered boards, set up at every possible angle, and bound into a kind of wall by every contrivance of post, or withy, or strips of rusty iron. The surroundings of each were equally nauseous; brown, dark slush that never dries. I picked my way to the chief of the buildings. The College is the name given to the composite group of about twenty. In Oxford it would rather be the university and the single buildings the colleges. But let that pass. Two only will I describe in detail. One is noteworthy because it can no longer be seen. The other may perchance still have held together.

The first, and the nearest the church, was a long cottage, two storied. It was almost in ruins. Only one half was habitable. The pig and privy slush permeated the fragments of the broken wall to within a few feet of the inhabited dwelling. The size of the rooms, above and below, was about nine feet square. In these two chambers the earthen floor of the lower rooms was scarce less crazy than the gaping planks of the latter. Nor was the moss-grown roof more dry than the reeking ground around. This building was the freehold property of the resident, who owned but the soil covered by the cottages, the piggery, and the intervening muck-covered ground. Thus instructed, I walked south some five yards to the adjoining tenement. It was a yet more wonderful freehold property. It measured in full ten feet by nine. The house covered the whole demesne, and not an inch of land outside it.



I.—THE COLLEGE.

All beyond was public way. The room above and the room below constituted the castle of three unmarried sisters. They each had some pittance from the parish, and held little intercourse with their neighbours. One poor soul had been bedridden for several years. She had harmless delusions of frequent communication with the unknown world, which made her an object of terror to all but her devoted sisters.



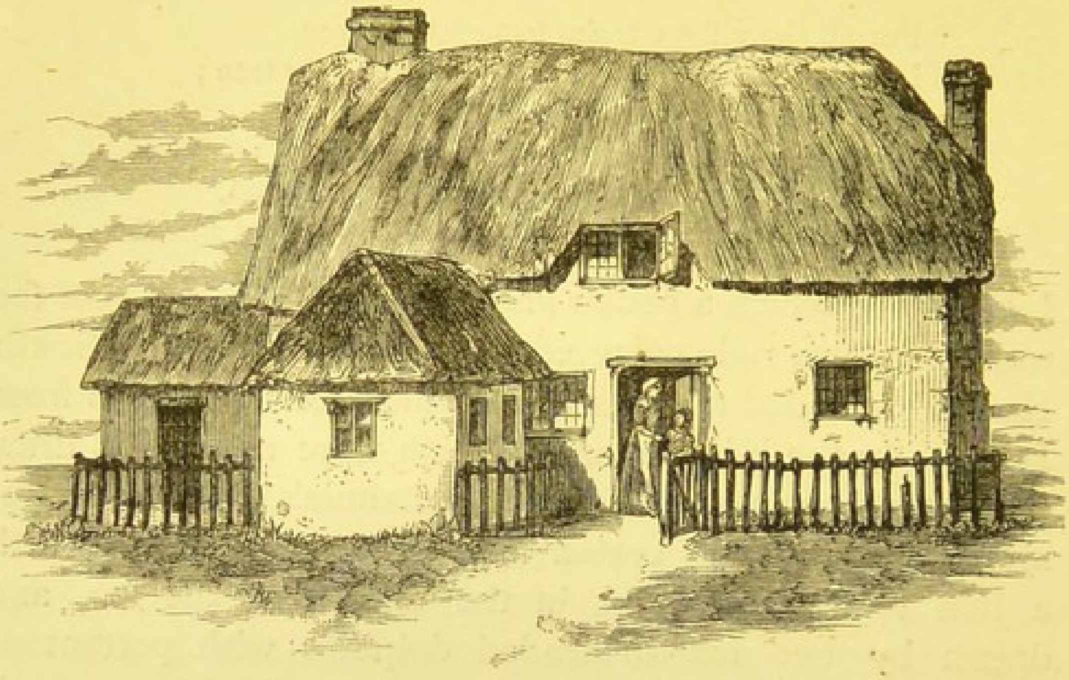
2.—THE BEDRIDDEN SISTER.

At this point my yeoman guide suddenly accosted me: "Well, sir, what do you think of our College? Would you like, sir, to see our drinking-water as well? maybe it will be a new sort to you, sir." We wound our way through the other dwellings. Each had a small garden, bright with flowers; some of them were very patterns of order and neatness. They were freeholds, of about four square perches each. Through open doors I could see pillows of lace-workers carefully covered over for the day of rest. We walked some two hundred yards across a grassy field. "There is our reservoir," he said, pointing to a shallow pit about eight feet across, full of brown peat-coloured water, which trickled over the lower lip of the crescent hollowed out of the sloping field. The footmarks and droppings of sheep and of cattle showed the spring of Stump well to be as popular with the quadrupeds, as needed by their masters. An aged dame just then came up, with a pail in either hand. "Good step from Summers Town on a hot night," she said. "How far?" said I. "Well, three quarter of a mile to my home—no water no nearer," she said. She filled her pails and returned. "You might like, maybe, to see Summers Town," said my grey-eyed companion. "It is a nice little lot of squatters—it is so." "Oh, squatters!" said I. "How is that?" "I will tell you. It was years ago that they took to enclosing the moor. It made a great change for us all. We all got on pretty well till then. We are a rough lot, but we understood one another. Why, how do you think they sometimes cured the bacon, till they was found out? This way it was. A lot on 'em agreed on a farm some miles off. They went in the night, got hold of a pig and killed it without noise, and brought it home. It was well known, but no one could ever trace these pigs. Then it was found out that they were cut up and stored away for salting on the leads of our church roof. But after this was known they had to give up that plan. Oh, yes; I mind very well the last of this. It was chiefly squatters as did it." I naturally desired to see alike the homes, and persons of the race. For the race I can truly say I found them much as other men, or perhaps more kindly. I have often seen them since. There is not now one that is not my friend. If we were not all harassed by the demand of certain professors of political economy to flout our affections, I might since have done more for them, and neither had been the worse. By this time we reached Summers Town. It was nearly dark, so that what I relate was not all learnt this evening. I presently turned back, wished my companion good-night, and walked briskly to the 'Bulldog.' It was surrounded by the quaint paraphernalia of a true village feast, with the still quainter owners, with their tight trousers, thin legs, and short overcoats. It had been the Marshmoor Feast the day before. The *débris* of gingerbread and tobacco-pipes strewed the ground. There were a few still drinking, strangers who had come to the feast to leave only on the morrow. Though the Morris Players had ceased a few years before in this part of England, yet the villagers had danced here till past twelve on this summer moonlight night, with homely fiddle and boyish fife, on the open ground :—

> " For all the village train, from labour free,
> Led up their sports beneath the spreading tree ;
> While many a pastime circled in the shade,
> The young contending as the old surveyed ;
> And many a gambol frolicked o'er the ground,
> And sleights of art and feats of strength went round."

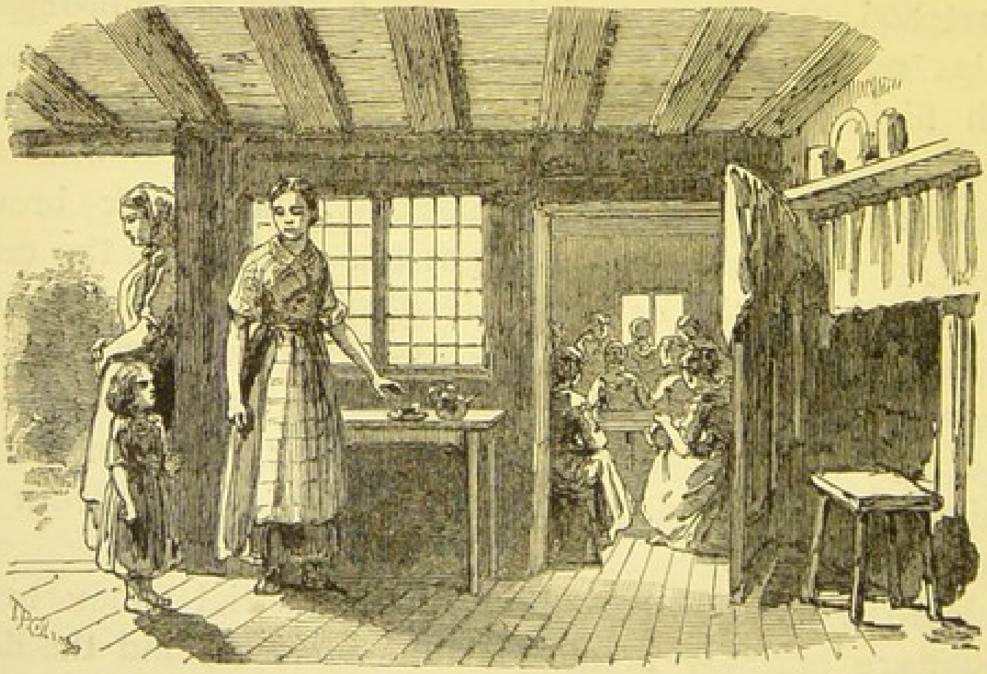
I got a bed which a pedlar should have occupied. On the walls were two rude coloured prints, invented before South Kensington ruled the arts and sciences of the nation from Lerwick to the Himalayas, and men were still left to draw their own " free hand." In one, 'Britannia's Glory' is represented by Britannia seated in a water-wheeled car, with a lion for her footstool, in the middle of the sea, and drawn by two mastiff-headed dolphins with portentous fins. In one hand is an ensign on a staff, with a portrait of Nelson with yellow hair ; and on the other is a figure of George III. in a full-bottomed wig. Neptune is swimming, the waves not reaching to his waist, with outstretched arms, one pointing to a fleet of full-rigged ships on the model of Dutch barges, and above him, in full flight, a fleshy cherub trumpeting his praise. On the mantlepiece were plaster cats, with coarse whiskers painted black, and plaster spaniels with thick brown dabs of paint promiscuously put on. I slept till the cries of the gipsies, the oaths of the showmen, and the shrill scoldings of the women awoke me at early dawn. I rose and visited Summers Town. The folk were already up; the men were off to work in the fields ; the women and children were already at their heavy task of piece-work in lace.

Here is the training-school ; an industrial annex to a squatter's ordinary home. It is now closed, and the deft little fingers ply no more. You can believe they had not much space, even if they had time, for the frolics of child-life. When I saw them, there were in a room nine feet by eight, and not seven feet high, thirteen children. Here they are happy enough, and very busy. Oh, shades of Howard and of Parkes, thirteen children in a cubic space of 504 feet!



3.—THE TECHNICAL SCHOOLROOM.

How did they accomplish the feat? I was chatting with the mistress of this school of technical instruction on the quantity



4.—THE INTERIOR OF THE SCHOOL.

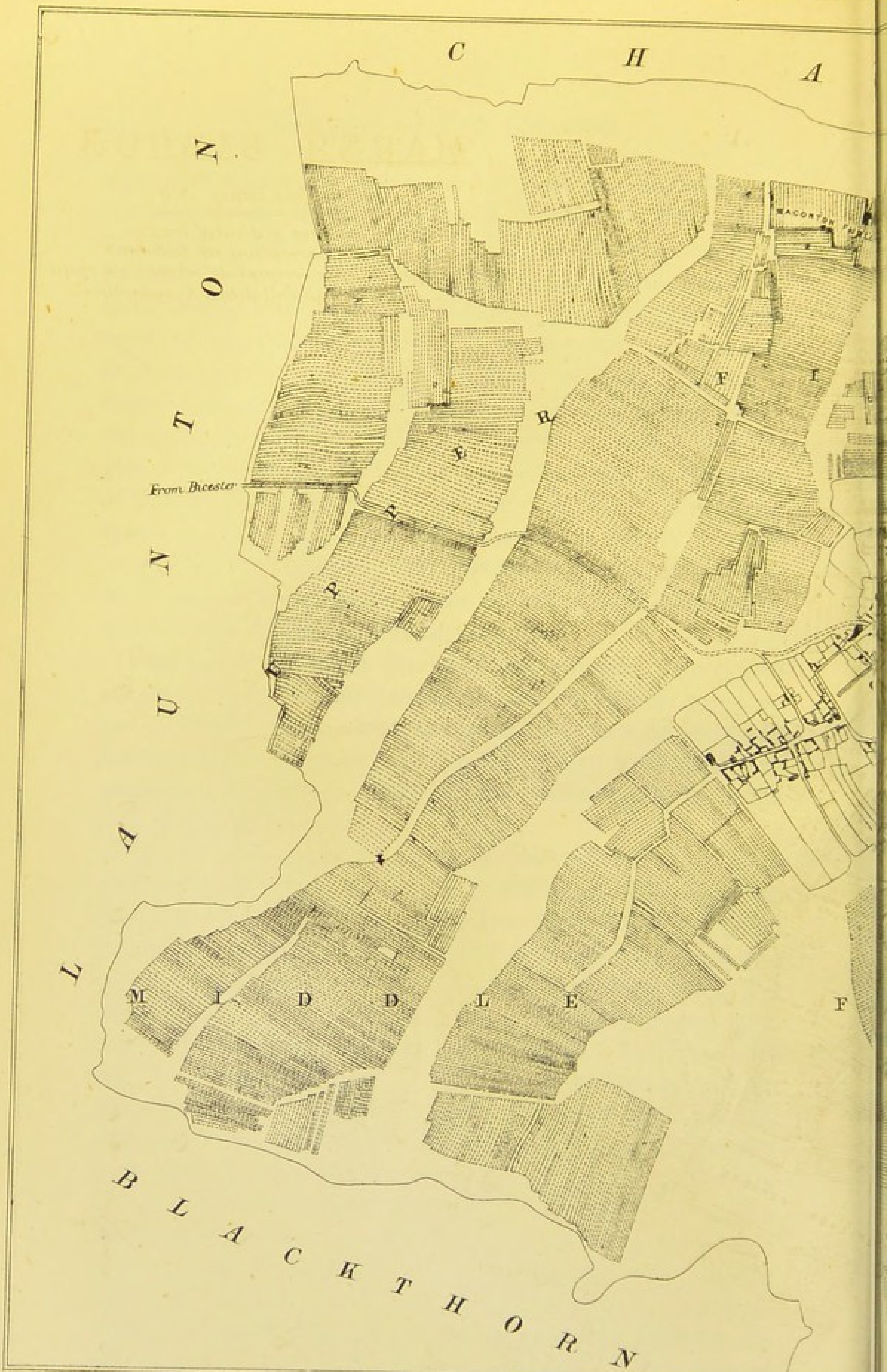
of lace that could be made, the money that could be earned and the school fees paid to her, when my old guide again appeared. "Good morning," he said, "you only see them now they are up. Have you a mind to look into a bedroom or two?" I assented. "Come, then: can you go up ladders? there ain't no stairs." We entered a squatter's hut not far off, and mounted a short and fragile ladder, of which two out of six rounds were gone. "There," says he, "them is eleven in family; parents, growed up girls and boys, and little ones, all sleep in twelve feet by ten! Oh! they does somehow; very bad for 'em all. You can't move betwixt the beds. The three Hares, though, ain't troubled that way, for they ain't got any." "How is that?" said I. "Why," says he, "they are three brothers that live together; live, I say; no one knows how they live. At all events; they goes out and goes in; and has food somehow. Here is *their* home close by: come and see 'em." The brothers Hare happily were in; they sat in a row on a log, which also served as the block whereon to chop their fuel with an old billhook.

This billhook is important as being one of five articles of domestic use which the Hares possessed, viz., the hook, two knives and a fork, with an iron pot. The log which I named, and a block of stone were all the furniture proper of the house. The official ladder was in the corner north of the chimney. A glance at the upstairs sleeping apartment showed only a heap of straw in one corner become soft by long use, and the fragments of old sacks,—the bed clothes. There was always some doubt as to the exact labour performed by the Hares. They had a worthy, steady brother, who lived under the same roof, in the adjoining hut, with his wife and seven children. They were a tidy, industrious family, with two well-appointed rooms. The ladder was whole, and was concealed by a clean cotton print curtain. The three bachelors were a thorn in the side of the married brother. He did not approve their gipsy ways. Some time after the date of this visit, he enquired of one skilled in the law if he might take steps to reform them. The exact reply I do not know, but the same day, the bachelors being away from home, he leapt on to the low roof, with a bar like the "Weaver's Beam," and before twilight, first roof, and then walls were laid low, and the bachelors on reaching home found themselves houseless. The result was on the whole satisfactory. The deed was counted to be on the side of order and morality—two bachelors took to more methodical ways, and one third only maintained the rights of vagrancy. He worked by day as much as got him food, and by night reposed without leave in his neighbour's linhays. His garments were latterly made by himself from old sacks which he begged of his friends. He refused the gift of a good, strong working suit to be made by the tailor of the neighbouring town; he would not have his measure taken. And so he lived. He read with facility, and for long attended church with punctuality and devoutness. A change of ministration thwarted his special convictions, and he ceased from his Sunday service.

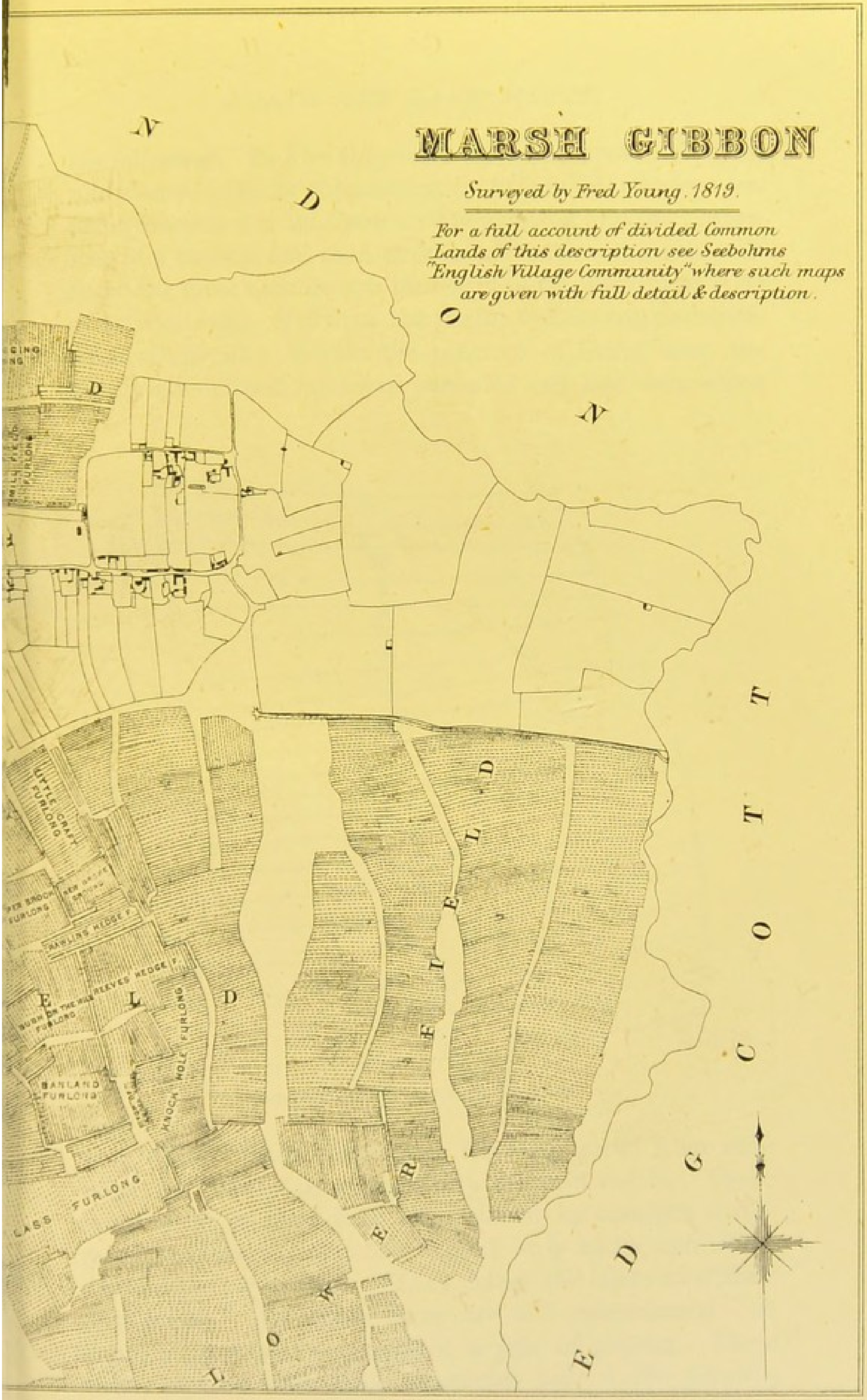
There was not much illness in the village. The parish surgeon was at this time, and is still, as most parish surgeons are, a kindly man. But the poor had then to send full four miles for necessary, and perhaps also sometimes unnecessary, medicines. This did not encourage in them the vice of polypharmacy.

To the row, or esplanade, of Summers Town there is no outlet behind. It was arranged in this wise. The squatters built unmolested on the twenty-foot grass waste of which I spoke. Behind the houses, and between them and the adjoining hedge, was a deep ditch. The plain being flat there is scarce any fall. Some of the twenty houses had, some had not, special rudely-built latrines. In either case the deep ditch was made by the daily excretions an elongated and hateful cesspool. Fever was not common.

It is not my purpose now to enter into historical details more than is necessary to illustrate the health conditions of a typical village, which exhibited with no fault of its own many of the evils as well some characteristics of the growth and making of England; but a few words may indicate how the village came to be laid out in the way described. The broad flat lands, some of the peculiarities of which we have seen, were given by William the Conqueror to one of


CHA
LAUNTON
From Bicester
WACORTON FARM
UPPER
FI
MIDDLE
F
BLACKTHORN

The dotted lines indicate the boundaries of the
no fewer than 3509 in that portion of the 2752



MARSH GIBBON

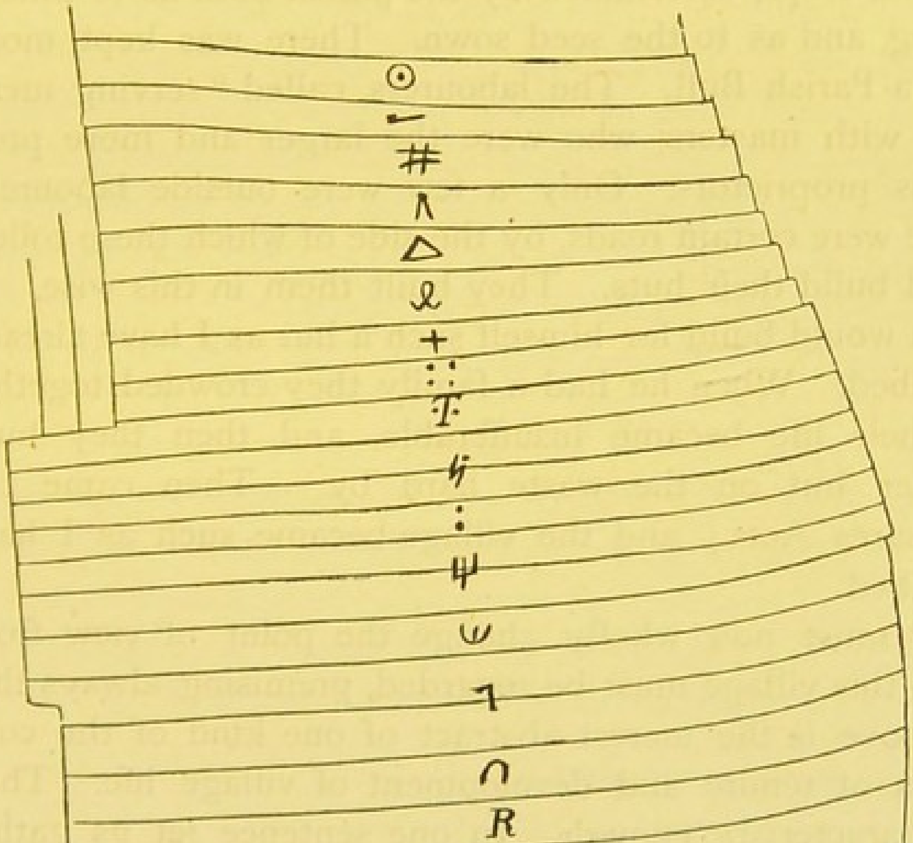
Surveyed by Fred Young. 1819.

For a full account of divided Common
Lands of this description see Seebohms
"English Village Community" where such maps
are given with full detail & description.

N D O N
D
LITTLE CRAFT FURLONG
PER BROOK FURLONG
HAWLINS HEDGE F.
REEVES HEDGE F.
BUSH ON THE HILL FURLONG
E L
D
KNOCH HOLE FURLONG
BANLAND FURLONG
LASS FURLONG
LOWER FIELD
EDGCOTT

nds . Of these there were in Marsh Gibbon Map
were so divided . The baulks are still visible .

his followers. By him they were bestowed upon a Norman monastery. On its suppression in France Marshmoor became escheated to the Crown. They passed into the possession of a charity, and then underwent but few changes. Of these the most notable was the effect of the Inclosures Acts of 40 years ago. Till then the parish system and parish life were all in all. Within the memory of living men, the wholly unenclosed land was parcelled out into lots, which



6.—LANDMARKS ON THE "LANDS."

were called "lands," and these were separated from each other by "balks," or strips, which are still visible. These lands seem to have been apportioned by common agreement to certain proprietors. Each strip had a sign which marked the ownership. "They called the lands after their own names." Of these many are still remembered. A hook, a pitchfork, a crowsfoot, a pair of pincers. These strips of land containing sometimes only a few perches, might be held singly by one proprietor. But in many parts of the divided lands in this parish one person would hold as much as three yardlands, (by a "yardland" was meant thirty acres), or he might have but one land of half an acre. Outside these apportioned lands all was *common*, with "common" rights enjoyed by the parishioners. Before the inclosure, all cattle and horses were necessarily tethered and watched, as there were no hedges. A straying animal might do much mischief, and quickly. The crops were rotation crops, determined by the parish both as to time of sowing, and as to the seed sown. There was kept, moreover, a Parish Bull. The labourers, called "serving men," lived with masters, who were the larger and more prosperous proprietors. Only a few were outside labourers. There were certain roads, by the side of which these toilers would build their huts. They built them in this wise. A youth would build for himself such a hut as I have already described. When he had a family they crowded together till their life became insufferable, and then they built another hut on the waste hard by. Then came the Inclosures Acts; and the village became such as I have described.

We must now wholly change the point of view from which this village must be regarded, premising always that the above is the merest abstract of one kind of the conditions of tenure and development of village life. They are characteristic enough. In one sentence let us gather up the ideas suggested by facts, visible to this day.

Look down from our grassy knoll upon the church (in this case dating from the 13th century) which was the centre of the parish life, and then on the manor house, the parsonage, the school, the village chapel—sign of freedom and dispute, the then hostelry—now the public house, the village pedlars, the rude development of rustic amusement; the games, the half savagery of the wandering men; the industry, the order of the better souls, the difficulties of growth without skilled guidance, and yet the yearning for a higher life, personal, political, and spiritual, which we find cropping up at every turn. Only once more let the saddened village Seer speak :—

> "A time there was, ere England's griefs began,
> When ev'ry rood of ground maintain'd its man;
> For him light labour spread her wholesome store;
> Just gave what life required, but gave no more:
> His best companions, innocence and health;
> And his best riches, ignorance of wealth."

Such then is my experience of what a village in England can be and has been, and is with some alterations even now. No evictions here, no tyranny, only the operation of natural causes, assisted, I am bound to say to some extent, by the generally beneficial Inclosures Acts. I do not doubt that upon the whole these Acts benefited the upper yeomen, and consolidated farming operations, as a study of the annexed map, and as Mr. Seebohm's book will show. As to the effect on the class below that is a further and different question.

This tale of Lowmarsh, when in type, was sent by me to a well-known Land Agent, who knew the place in 1858. *He has travelled in his profession, from then till now, throughout all England. He returned me the proof, with the following comment, of the truth of which I am too sadly aware :—*

"Your picture of Lowmarsh in its old days is a very faithful one in its most pleasing, or, perhaps I should say, least shocking moments. But I certainly knew it in phases and moods which are strongly and painfully impressed upon my memory, and which your more pleasant picture does not recall to me. I ever think of the squalid misery of poor, wretched, woebegone men and women, and above all, of children, from whom happiness of any wholesome kind seemed hopelessly gone; the hungry, half-starved families crowding round a miserable bowl of potatoes, often without even a bit of bacon, and thankful indeed to get it, supplemented with a supply of bread and weak tea; the miserable girls of 15 or 16 years of age, with still more miserable puny babies in their arms, clothed in rags, and, as a matter of course, illegitimate; and the reckless and sullen fathers, ready to hate and curse, and with very little encouragement, to do worse than that. These also were only too common in those days, and were the fruits of the circumstances in which they, poor people, were compelled to live. I think a complete picture should have some reference to them."

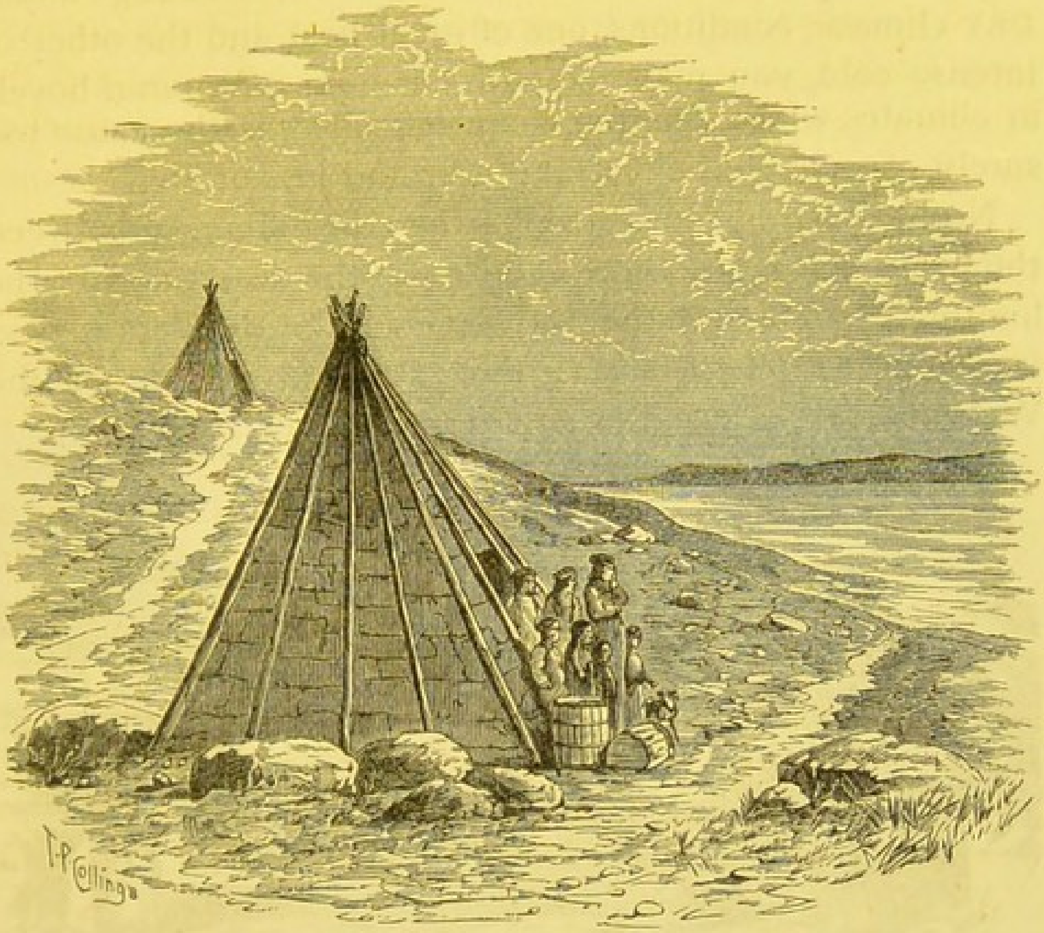
The land agent being a gracious man leaves me to complete my own picture. I will therefore add yet one touch in black, and one in white. Tom was a wild man and lived a rough life. He never took kindly to reproof. The agent crossed Tom's mood. Like lightning he rushed for his axe to cut off his visitor's head. The agent stood firm and still; the uplifted arm fell powerless. The grey-eyed yeoman witnessed this scene. On Tom's behalf he says to this day, "Tom was a rough man; but Tom wouldn't never have took to his axe to chop off the agent's head in Lowmarsh if he warn't more hot than usual." So in this state of human degradation there comes ever and anon the touch in white which I promised, "Blessed are the peacemakers."

Various Health Conditions in Villages.

Four instructive instances of the effects of very dissimilar conditions upon human dwellings may here be shown by the woodcuts which follow. They are taken from sketches drawn on the spot by myself at various times since 1834.

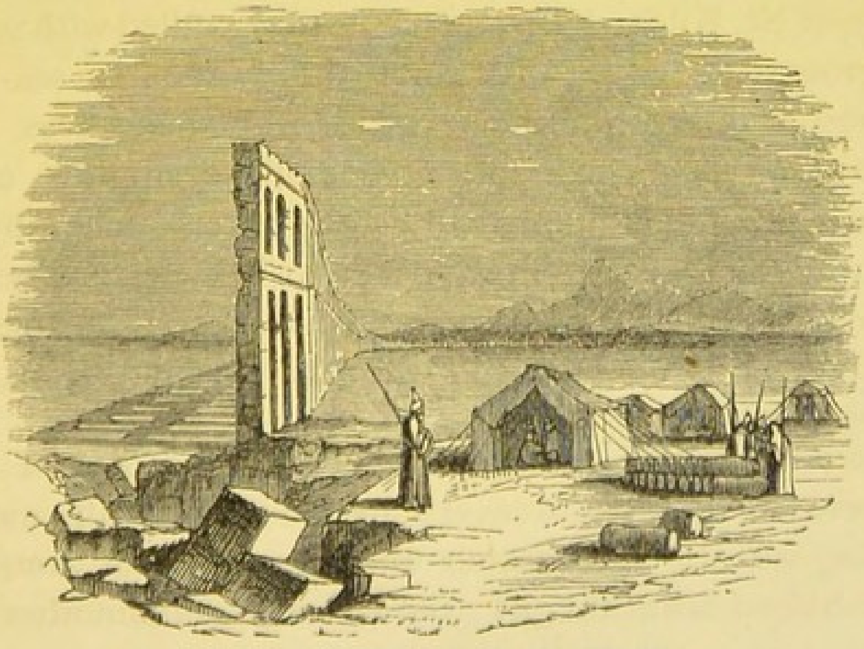
The first is a Micmac Indian wigwam in Nova Scotia, on an open breezy site. There is ample space about it. It is easily left when offensive or inappropriate to the few wants of the inmates. It is on a slope where natural drainage is perfect, and it is near the lake for canoe and fishing.

The second is a collection of Bedouin tents between Tunis and Zagouhan reposing awhile under the shadow of the great aqueduct which supplied a copious stream of pure water to Carthage. They are on an arid, porous, sandy soil; the sun and the soil all tending to the comfort and perfection of armed gipsy enjoyments, though in fact full often offensive and foul.



7.—THE WIGWAM UNIT OF AN INDIAN VILLAGE.

By the side of the tents are rows of wicker bee-hives, showing the pleasing bee-keeping industry so prized by

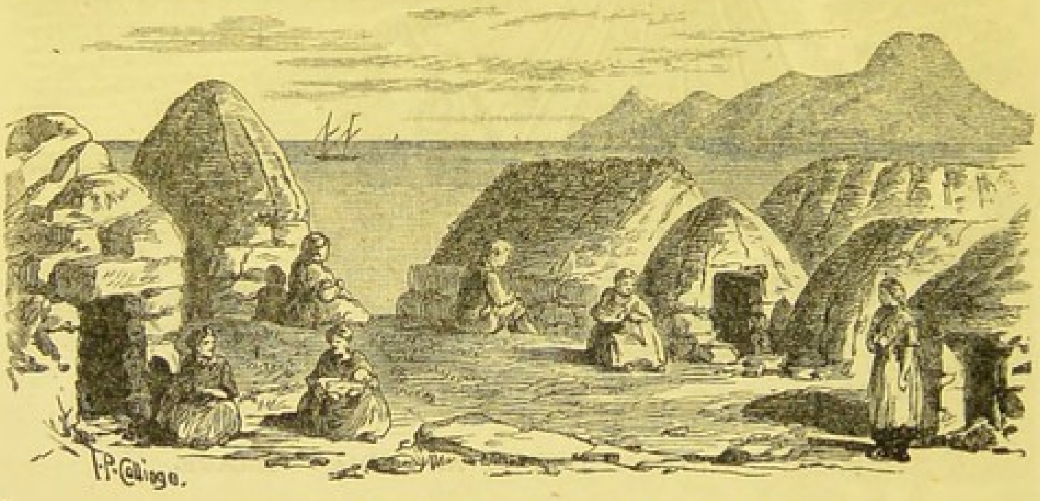


8.—BEDOUIN TENTS NEAR CARTHAGE.

these tribes, and so often neglected now in the villages of England.

In contrast with these frail tenements, existing under DRY climatic conditions, one of great heat and the other of intense cold, you may compare far more *substantial* hovels in climates where dampness, uncontrolled, is the cause too surely of enfeebled physical power and loss of life.

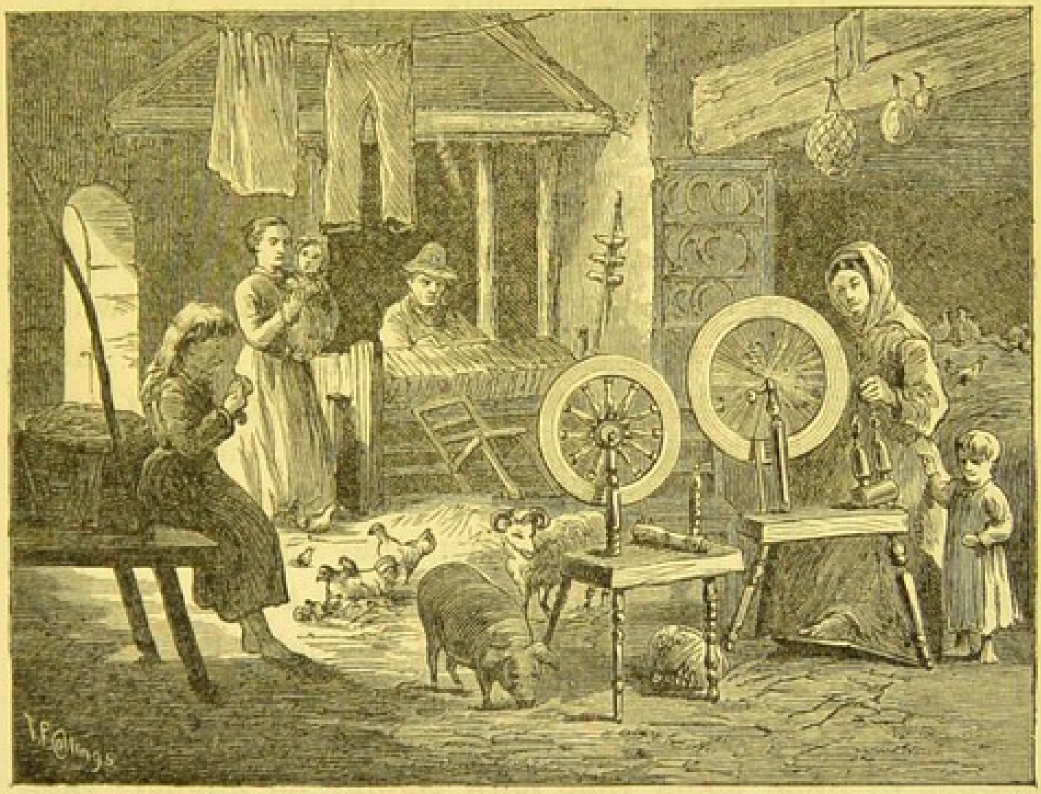
Nothing can be more striking than the difference between the health-aspect of these children of the desert and of the hunting-ground, and that of some of the dwellers in less favoured districts, such as the saturated islands of the Western Hebrides or the Atlantic coasts of Ireland.



9.—THE VILLAGE OF ST. KILDA, 1834.

The above sketch shows the low huts constituting the village of St. Kilda, drawn by me in 1834—filled with smoke, the ground saturated with offal, the entrails of sea-birds, the resting-place of their cattle and themselves alike. The second is an example of one of the brighter cabins of the Celtic inhabitants—drawn two years since by Mr. Muirhead and myself in the west of Donegal. The two first of the four sketches are suggestive of activity, freedom, and the winds of Heaven; the two last of damp, discomfort, and dirt.

The Arts have advanced indeed in the cabins of Erin. The weaver and the weaver's loom; the distaff and the spinning-wheel; the mother and the infant in arms, the bright-haired beautiful girl; the wizened grandmother; the babies, the fowls, and the cat in a common bed; the inquisitive swine and panting sheep; the floor of earth, and thereon the chimneyless smoky peat; the outside of the hovel all slops and muck and refuse from the ruined cowshed—all set forth conditions in which mankind live, in which family life is often virtuous, bright, and not unhappy, though in it are found all the conditions for making that life a burden and that family a hotbed of crime and of vice.



10.—THE WEAVER'S HOME IN DONEGAL.

Both time and space forbid me from giving other descriptions of Village life among the nations of the earth. It were easy, indeed, to draw similar contrasts in various parts of Europe—in Norway, in Switzerland, in Italy, in France—without going so far afield as India or Africa, or the countless modes of existence in the continents and islands of the Southern Hemisphere. I will therefore conclude this portion of a rough sketch of Village life by the following extract from a Report on the Village of Great Horwood which I drew up in the year 1858. I insert it, because from the perusal of these facts, together with those which I have already presented, and the inferences which may be justly drawn from them, the account of which will presently follow of the simple requirements of a healthy village will be more interesting, and the lesson to be drawn will be more convincing.

"The causes of disease that are common to all these houses are offensive exhalations of some kind adjoining the houses, coupled with deficient ventilation in all the rooms, and more particularly in the bedrooms. In some of these good health is impossible. There are doubtless, in Horwood, many sanitary errors, but scarce any that may not be found in hundreds and thousands of other rural parishes.

"In most agricultural districts there are many points connected with the older dwellings, which are either remediably or irremediably bad. Some have thatch, where they should have slate; half-bricknogging, when there should be walls of the thickness of a brick and a-half; and porous, absorbent tiles instead of hard flagstones, or wooden flooring. They have rooms six feet high below, or even between the rafters, when they should be 7 feet 6 inches, or 8 feet, as a minimum below them; the door and the windows are not seldom on one side of the house, whereas there should be a back door and windows at the back for through draught; they have one casement of the window to open when they both should be hinged; they have a pantry without a window, when it should always have free access to the outer air. Some have a small ladder to the bedroom, instead of convenient stairs; have one bedroom window a fourth of the proper size on the floor below the wall plate, or on the floor, dormerwise, instead of two against the ceiling; and allow in some instances but half of the cubic air space for two adults which should be allowed to one. Every such fact may be seen in most agricultural districts, which have not been thoroughly taken in hand by influential landlords.

"Nor is this all; the exterior of many of the dwellings is no less unsatisfactory than the interior. In some instances, even if the dwellings were better than they are, the gardens might cause disease. Into one an open privy overflows; into another the refuse of the house is thrown near the door, and forms a putrescent heap round which the children play; from it the father, as he returns home weary from a breezy field, inhales foulness which blasts the energy that the hours of night should give.

"The evils which are alluded to, which might be much enlarged upon, were pointed out long ago in the Reports of 1842 on the labouring population of England. Those who are ignorant of the habits and dwellings of our rural populations would be surprised to find how little the labouring classes interest themselves in improving their cottages. If a drain be out of repair, it is usually left untouched until the owner of the property becomes aware of the defect; and if the privy becomes full, it is left uncleaned until the increase of the soil renders the accommodation inaccessible. To the state of the privies in the cottage gardens is attributable more illness than to any other cause. The construction of these conveniences is usually of the rudest character, being nothing more than a hole dug in the ground. In the course of time the soil rises in these holes to the level of the surface mould, when a natural drain is formed beneath the cottage floor, which is usually lower than the surface. In a row of cottages on a dry heath in Buckinghamshire, I was surprised to find fever prevailing amongst the inmates, who were agricultural labourers, possessing unusual advantages. The cottages had been constructed with much attention to the comforts of the inmates; yet by the neglect to empty the privies, the vegetable mould beneath the floors had become thoroughly saturated by the drainage, thus producing frequent and serious indisposition amongst the inmates.

"The following history gives probably an example of the two simplest modes of origin of fever; the one by poisoning through malarious exhalations from the soil, the other by infection from a person already ill. A young man dug the foundations of a wall at Horwood, on a spot where refuse and ordure had been accumulated ; he went home to Winslow and had fever. Two brothers and a sister have since fallen ill in the same house ; all are recovering.

" Compare the following. The cottage which I should designate as the most dirty, worse kept, and on the whole, as far as I know, most unsatisfactory cottage in Horwood, has not had a single death. One inmate had severe typhus twelve years ago, and more than one minor attack since. Three slight cases have occurred in the house this spring ; all the inmates are always unhealthy ; but in this endemic, though no one has been very ill, no one has been well in it.

" In truth, where a combination of circumstances is required to produce the disease, people seem sometimes to escape because they are worse off than their neighbours ; just as in the thickest of the fire a man escapes, while a single chance shot kills his comrade. A parish house, near the village, which seems positively dangerous, is two feet below the road, and has the floor three inches below the door sill, is yet airy, because it is large and out of repair ; the bedroom looks miserable, and has no ceiling at the collar ; but if it were tiled, from the reasons given, would be healthy enough. I have seen in Oxfordshire and Bucks many such houses, and have heard the people say 'they prefer them to (what they call) the better sort : to be sure they look slovenly, but you see, sir, we have room to move, and fresh air.'

" Again, a positive good is neutralised by one carelessness. It has been already said that some of the cottages have no back door ; it is almost impossible that a labourer's dwelling should be healthy when this is the case. This fact alone condemns the construction of the new buildings at Nash End, and renders them dangerous. But, on the other hand, a back door may lead to concealed and confined filth, unless there be adequate space behind. Lately I asked, during a sanitary inquiry in a house to which there was a back door, where the privy was placed. The answer was, 'Mine ain't a privy, it's a tub !' The tub was, among other articles of domestic use, at the back door. The object was to collect the manure for the garden.

"Or compare these two instances: in one charmingly kept cottage, with a capital garden, the whole of one side of the garden is occupied by a privy; its overflow, a general swamp, 9 inches deep, for the pig to play in; and his stye; and in the tenement next to it, were is a similar arrangement, there has been scarcely any illness in this house. The pigs' swamp is open (*i.e.* has no roof), and the bedroom window is not over it. But in another cottage, where the bedrooms are larger, the window is over the roof of a reeking pig-muck, and the strong man that slept by the window fell ill and died, and his widow is yet struggling for life.

"There is no reason for supposing that the food is inferior, or the general condition of the labourers at all worse in Horwood than in agricultural districts generally. On the contrary. The allotments which were apportioned to them when the common was enclosed have greatly helped them in providing the house. But I fear also that the muck has been treasured up, and more pigs kept close to the cottages, for the purpose chiefly, if not wholly, of supplying manure. The water is obtained chiefly from wells, and is not complained of. That obtained from the rivulets is not fit for drinking, and is not used for it. The south-eastern rivulet, as it flows at the back of the Wigwell, is often impregnated with oozings from cesspools, and from surface refuse.

"It remains only now to sum up into a few words the conditions which appear to have favoured the development of fever in these cottages. They were destitution, bodily and mental depression, contagion, over-crowded dwellings, putrescent animal and vegetable matter, and an insufficient supply of fresh air, or, as it is called, bad ventilation. We must attribute the persistence of the affection in various degrees to the last four, and especially to bad ventilation. The evil is most grievous in the sleeping-rooms. 'We can do no more,' said one admirable woman, 'than keep clean that which we have. We cannot get our landlord to give us more air, or make the windows we have to open. "Women," he said, "are best shut up."' Some of the small cottages at Wigwell are models of personal cleanliness and of neatness on the part of the inmates. The fault is not in them, but in their tenements. So offensive do the bedrooms of some become in the rooms where the windows are near the floor, that one said to me, 'I often awake in the night stifled, and me and my husband go and sit at the window.'

"Too much stress cannot be laid on this. It is an evil, which the inmates cannot, with their present education and notions, rectify. It would seem very easy, by borrowing a tool or two, to make, at the cost of a little labour and the exercise of a little wit, an additional window in a roof; but, 'it is the landlord's place' to do it. He does not know of the necessity, or has not the means, or doubts the soundness of what he considers sanitary innovations. And as for the father, he comes home tired. From day to day the old small casements remain; no better are substituted, and none are added.

"To this I must only append the oft-repeated caution against the accumulations of muck, filth, and piggeries close to human dwellings. The great difficulty of the case must be admitted. Custom, convenience, poverty, want of time, family cares and close living, combine against the formation of the energetic moral habit which leads to the most healthful state of body and mind. With many, therefore, the difficulties of living are barely surmounted; complete mastery of their circumstances is seldom attained."

At the time when the above passage was written it had hardly been generally recognised that typhoid fever* ravaged the dwellings of the agricultural labourer as certainly as the alleys and courts of our large towns. This fact is now thoroughly established, and has led to the publication of many admirable works, more or less detailed, on the condition of the farm labourers. Now that, as a consequence of the Sanitary Commission of 1870, a medical officer has been appointed for every spot in the kingdom, under a special sanitary authority, it can only be a question of time when truly evil conditions shall cease, though it was calculated by Lord Napier and Ettrick[*] that it would cost seventy millions sterling to rebuild the 700,000 labourers' cottages which he concluded would need reconstruction in Great Britain.

---

* See Registrar-General's 21st Annual Report, 1860, p. xxv.

The remarks which follow now will not be confined to the question of cottage building, but will comprise the general conditions which may be assumed to be desirable for health in a village. It was nobly said by Michel Lévy, and cannot be too often repeated, "l'Hygiène c'est la moralité et l'aisance." Public and personal health rest on morality and competency. Morality and order are the presumed foundation of the parish system: competence is to be attained by the toiling dwellers in the country, through the possession of adequate land, or of adequate wages, *with industry and contentment.* It is obvious, however, that the political principles, and the relation of the population to the land and to manufactures, touched on in this statement, involve questions which lie at the root of the national life, and cannot be discussed here.

II.

THE NEED STATED.

1. General Requirements for Healthy Village Life.

The health, then, of a village depends chiefly upon these factors :—

1. The Dwellings.
2. The Water-Supply.
3. The Removal of Refuse and Drainage.
4. Education, Occupation and Recreation.
5. Care in Sickness.

---

[*] Transactions of Social Science Association, 1872, p. 22.

1. DWELLINGS.

In considering what houses are to be recommended as the best units of dwelling in a village, it has to be remembered that it is not possible to name any plan which is actually the best, or which is either desirable or possible for all villages. It is, however, easy to say what are the essentials of all fairly good, though humble, houses for the families of an agricultural labourer and for the other classes of inhabitants in a rural village. In every mixed village community in this country there are to be found as occupants the parish clergyman, possibly the squire, perhaps also the doctor of the district, the small shopkeeper, grocer and mercer, or keeper of a general shop, artizans, *i.e.* carpenters, masons, wheelwrights—not often the glazier or painter, possibly a farrier, butcher or pork butcher, baker, shoemaker, one or more publicans, and by chance other trades and occupations depending on the local conditions of the district about the village. But of these last it is not necessary to speak, for these persons are generally provided for, either by themselves or by their predecessors in the same occupation. They constitute only individual cases, and have not to be considered as a large class. But besides, we have chiefly to regard the active agricultural labourers; to whom must be added the aged, the unmarried, and those without families who do not require such a cottage as is needed by a man in the prime of life who is maintaining and bringing up a family. This is all well known to every one of every class who has ever lived in the country for even a short time.

In building, then, a labourer's cottage, the following points have to be considered and decided upon:

1. The site, the general materials—stone, brick, concrete, cob, wood, iron; the walls—hollow, solid, plastered; the character of the windows as regards ventilation and light; the material of the roof; position of the door or doors; the floor; warming; cooking, and washing.

2. The water-supply.

3. The drainage.
4. The cost and the principle on which rent is to be fixed.
5. The garden or allotment, or both.
6. The pig-sty.
7. The approach.

Upon carelessness in any one or more of these details a large part of the comfort and character of the rural population throughout the world depend. Many of the details are regulated by local custom, and by local conditions; some by geological formation, as regards material and water-supply; and some by the conveniences or difficulties of transport. In this country, however, the last is rapidly becoming everywhere equalised.

It is not in the province of this paper to discuss in detail the work of the architect or contractor. Certain general principles should, however, be stated.

As regards the site, it would not be recommended as a good rule to follow the practice of more than one speculative builder, or even, as has been observed in towns, of more than one member of a Sanitary Board, and to purchase cheap suburban lands—cheap because too low and wet, or foul for garden ground—and run up artizans' dwellings thereon, knowing the water to be within nine inches of the surface, and then not even attempting to lay down a concrete floor. These days are past, at least Sanitary Authorities can and should stop the erection of such buildings. In villages generally, the site depends on the convenience of the situation. None should be sanctioned where drainage and dryness of soil are impossible. A layer of concrete should be laid over the whole area to be occupied by the house. A damp course of pitch or of cement and slate, or the hard stoneware perforated tiles now to be obtained at no great cost, should be built in. The last seems to be far the best; and sleepers for supporting floor joists should be of the same material.

The plans which follow may be taken as a standard for a convenient labourer's cottage, containing every actual requirement on a moderate scale, for a family consisting of the parents and five children.

The following comprise the chief provisions :

1st. A living room, with superficial area of about 150 sq. ft. ; and a capacity of 1275 cubic feet, *i.e.* 12 ft. × 12 ft. 6 in., 8 ft. 6 in. high.

This is entered by a snug porch with a double door. Through the porch is also a small ventilated pantry approached from the living room without opening the outer door.

2nd. From the living room is (1), a door to the bedroom floor ; and (2), a door to the washhouse immediately opposite the back door.

In the washhouse are a fireplace, a copper containing 10 to 16 gallons, and a sink.

All washing and cleaning operations of the family are carried on there. No steam need enter the house.

The staircase leads to three rooms.

3rd. The parents' bedroom, 150 sq. ft. area × 8 ft. 3 in. high, giving nearly 1250 cubic feet, fireplace, and ample window.

4th. Girl's room, about 100 sq. ft. area × 8 ft. 3 in. (825 cubic feet), fireplace, ample window.

5th. Boy's room, 90 sq. ft. area × 8 ft. 3 in. high (740 cubic ft.), ample window, door opening to the head of the staircase, in which there is thorough ventilation by opposite windows.

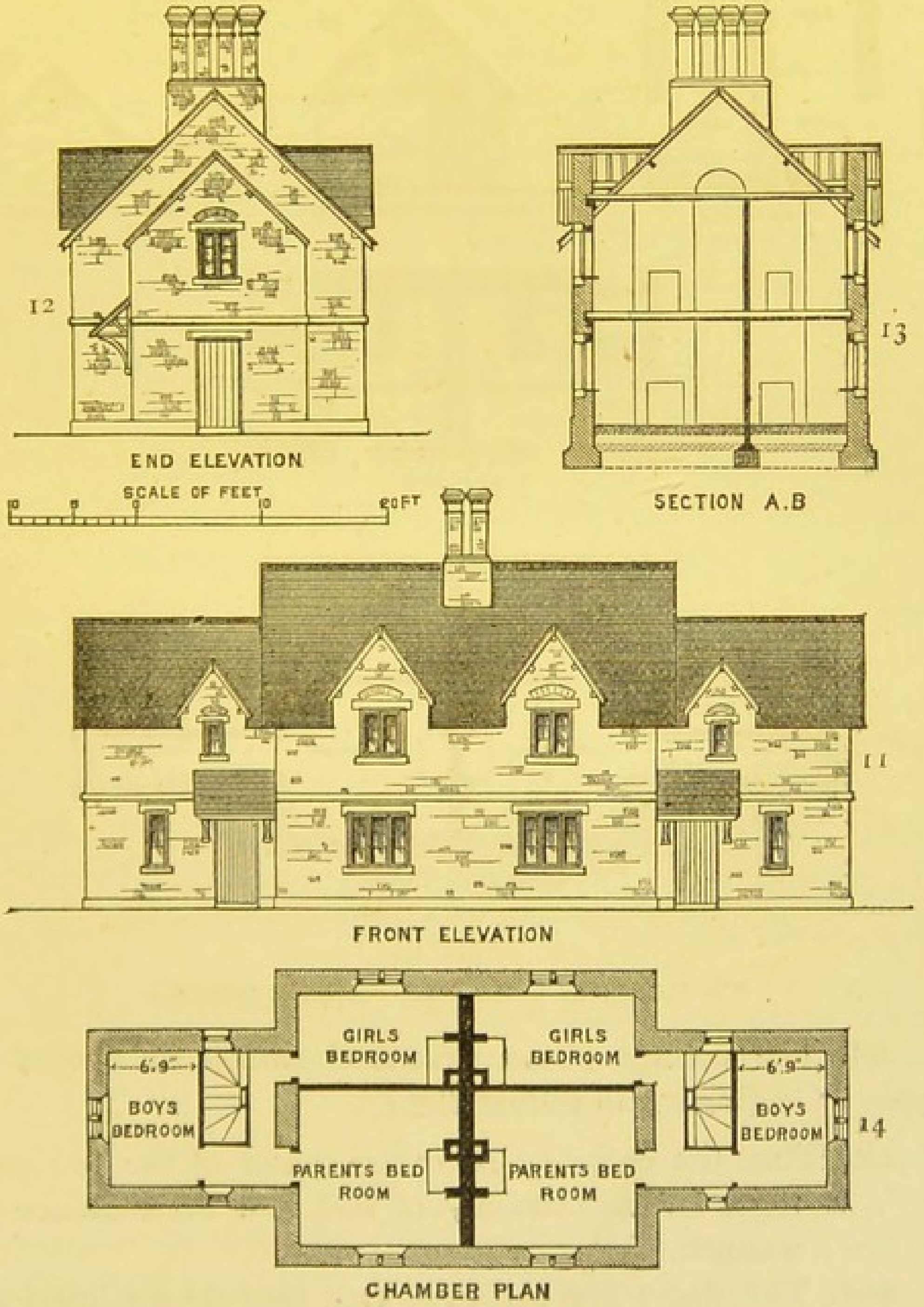
6th. The staircase is a means of thorough ventilation in itself ; and for all the rooms on either floor, by setting open the downstair door.

7th. Outside the washhouse and beyond the pantry is an ample fuel-house, about 36 sq. ft. area.

At the back of the cottage, removed to a convenient distance, say 20 ft., is a bakehouse with oven, including store room for faggots and brushwood. On one side of the bakehouse is an earth-closet and ash-heap under shelter.

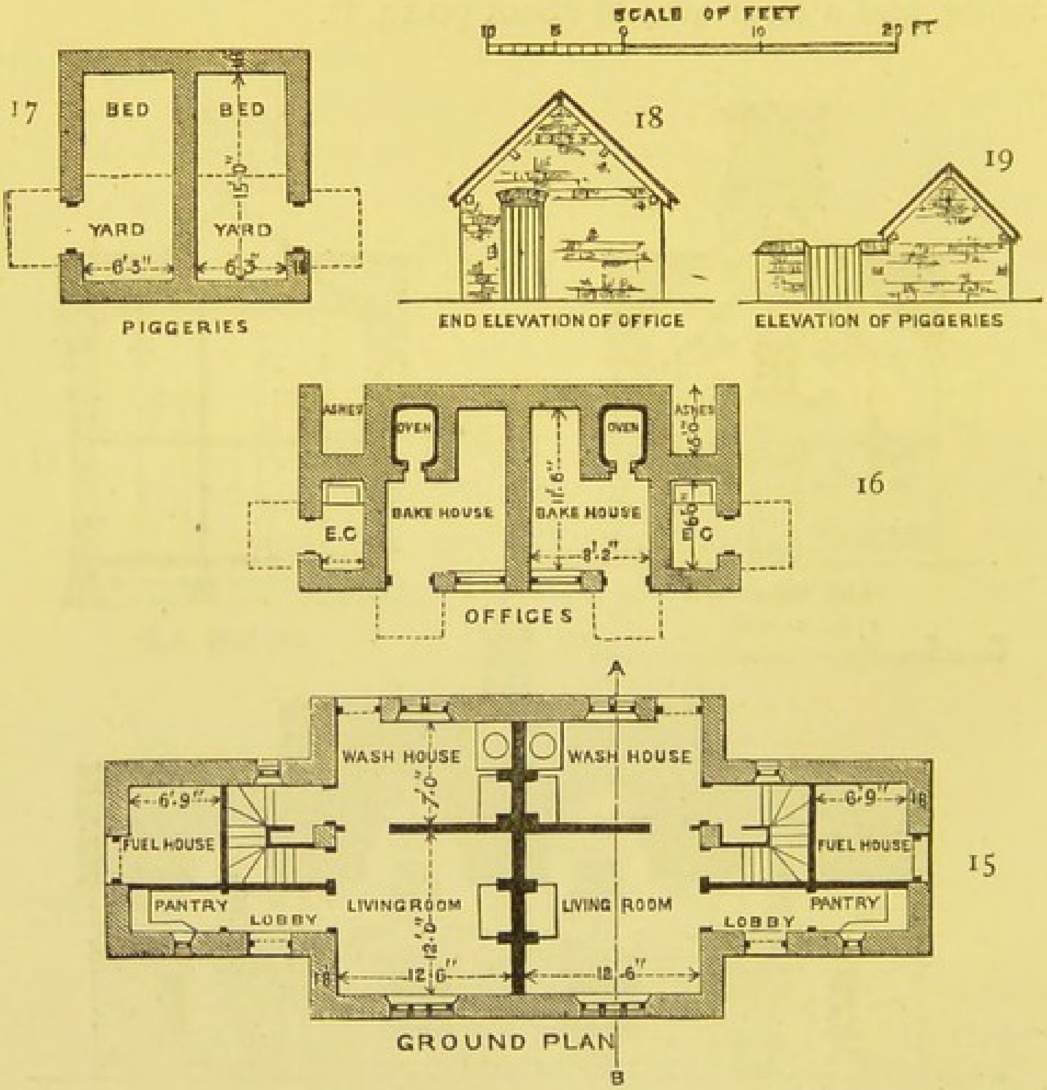
Of this more hereafter, in considering the arrangements for drainage.

To the rear again of the bakehouse towards the end of the garden is the pig-sty, solidly built, with yard and pig-house, and a clear area of about 90 sq. ft.


12
END ELEVATION
SCALE OF FEET
10 5 0 10 20FT
13
SECTION A.B
11
FRONT ELEVATION
GIRLS BEDROOM
GIRLS BEDROOM
6.9"
6.9"
BOYS BEDROOM
BOYS BEDROOM
14
PARENTS BED ROOM
PARENTS BED ROOM
CHAMBER PLAN

STANDARD COTTAGE. (MARSH GIBBON.)

It is not, as I have said, the province of this paper to usurp the functions of the architect. But the above few facts being taken as the basis of the requirements of a farm labourer's cottage, certain generalities on cottage building from the point of view of health may be added.


SCALE OF FEET
10
5
0
10
20 FT
17
BED
BED
15'0"
YARD
YARD
6'5"
6'5"
18
PIGGERIES
18
END ELEVATION OF OFFICE
19
ELEVATION OF PIGGERIES
ASHES
OVEN
OVEN
ASHES
BAKE HOUSE
BAKE HOUSE
11'6"
8'2"
E.C
E.C
OFFICES
16
A
WASH HOUSE
WASH HOUSE
7'0"
6'9"
6'9"
18
FUEL HOUSE
FUEL HOUSE
PANTRY
LOBBY
LIVING ROOM
LIVING ROOM
LOBBY
PANTRY
12'0"
18
12'6"
12'6"
GROUND PLAN
B
15

NO. I. STANDARD COTTAGE. (MARSH GIBBON.)

1st. The cottage above described should be one of a pair. On this it will follow that:

1st. That the chimney is in the centre of the two cottages for the economy of fuel, and maintenance of warmth.

2nd. The doors are placed so that they do not interfere with the space round the fire, nor with the window.

3rd. Three-fourths of the room are therefore unbroken by doors.

4th. The staircase and pantry act as an air jacket, being on the outer side of the living room, of which one side only and a bit of another are exposed to the outer air. A few feet area in this plan are given to the upstairs lobby to the abstraction of the same from the rooms. This is a choice of difficulty. The staircase is winding—an arrangement inconvenient for an adult coffin, but difficult to plan otherwise without loss of space.

5th. In three-light windows, two at least should open. In two-light windows, both. Window heads are to be close to ceiling. Window fastenings always to be made to allow window either to open wide or be set ajar.

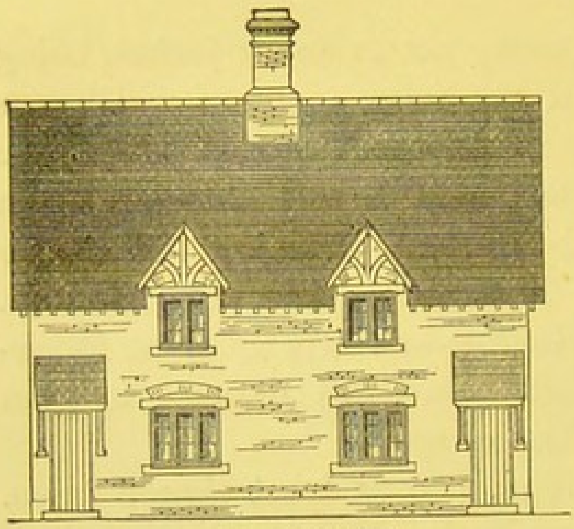
6th. The roof should be lined with plank.

7th. The whole area beneath the ground floor should be concreted. The sitting-room floor should be partly laid with best hard tiles near the fire, or in some districts with slate. The best material for the rest admits of question. *Inspectors* say *wood.* Those *who use* the floors usually say *stone* or brick.

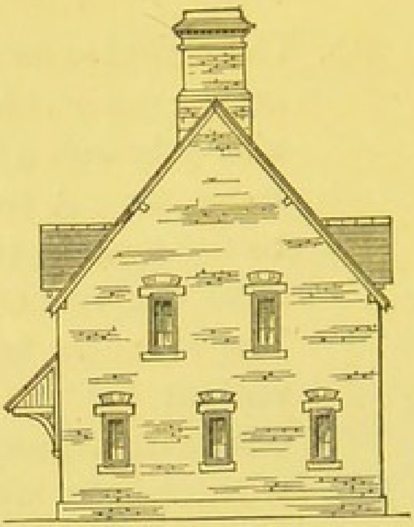
8th. The aspect of the cottage should be, if possible, one facing the half cardinal points S.W. and N.E. back and front, rather than due north and south.

9th. The plans here described *were* built in Mid-England for £300 the pair, no great sum. At present, this would not be undertaken for less than £370 or £380.

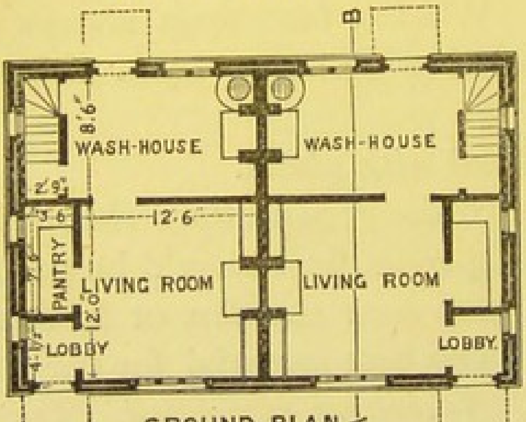
In the following plan the principles laid down above are generally followed. The arrangements and materials will be such as to reduce the cost. It will be noticed, however, that the fuel house, pantry, and staircase are disposed so as to give the least amount of wall and angle work, though the dimensions are but little less. The block is rectangular, and the walls are double, or hollow walls in bonded brick. The offices are reduced in cost by the extent of roof over the ash floor. This probably is to be built as cheaply as a good cottage of the plan described



FRONT ELEVATION

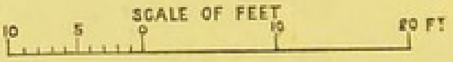


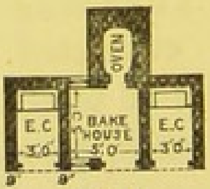
END ELEVATION


B
WASH-HOUSE
WASH-HOUSE
8.6″
2′ 9″
3.6
12.6
7.6
PANTRY
LIVING ROOM
LIVING ROOM
12.0″
4.1½″
LOBBY
LOBBY.
A

O

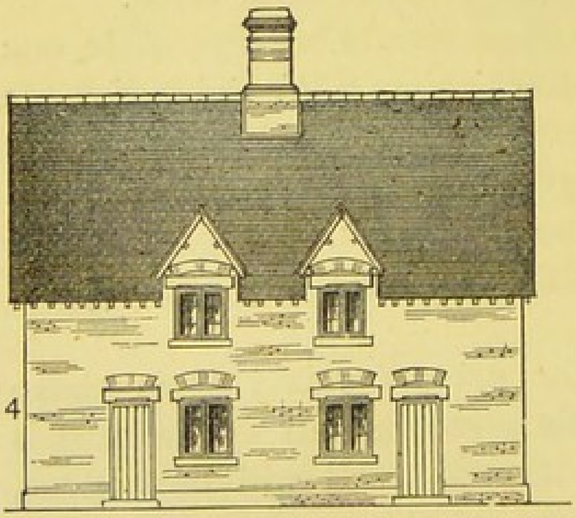
GROUND PLAN


SCALE OF FEET
10
5
0
10
20 FT


OVEN
E.C
BAKE HOUSE
E.C
3.0
5.0
3.0
9″
9″

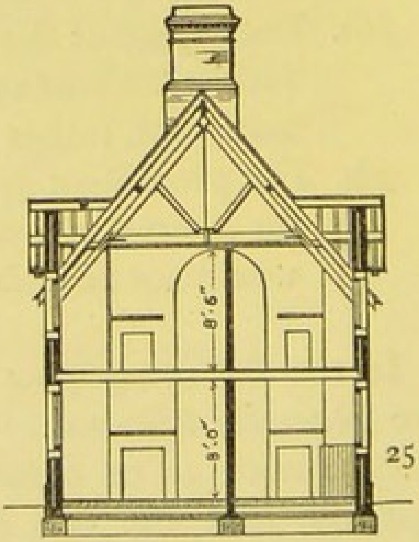
26

PLAN



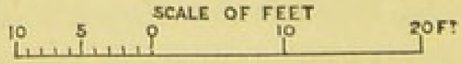
4

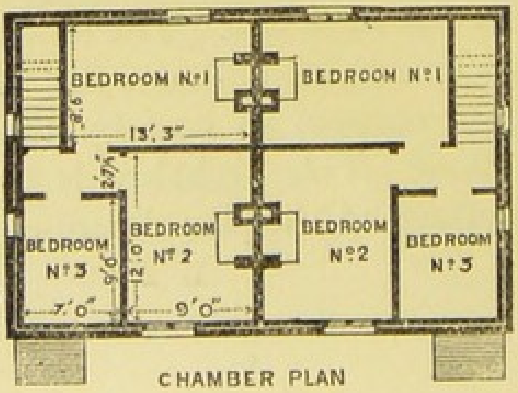
BACK ELEVATION



25

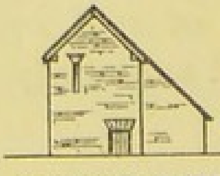
SECTION A.B


SCALE OF FEET
10
5
0
10
20 FT


BEDROOM No 1
BEDROOM No 1
8.6
13′ 3″
2′ 7½
BEDROOM No 3
BEDROOM No 2
BEDROOM No 2
BEDROOM No 3
9′ 6″
12.0
7′ 0″
9′ 0″

3

CHAMBER PLAN



27

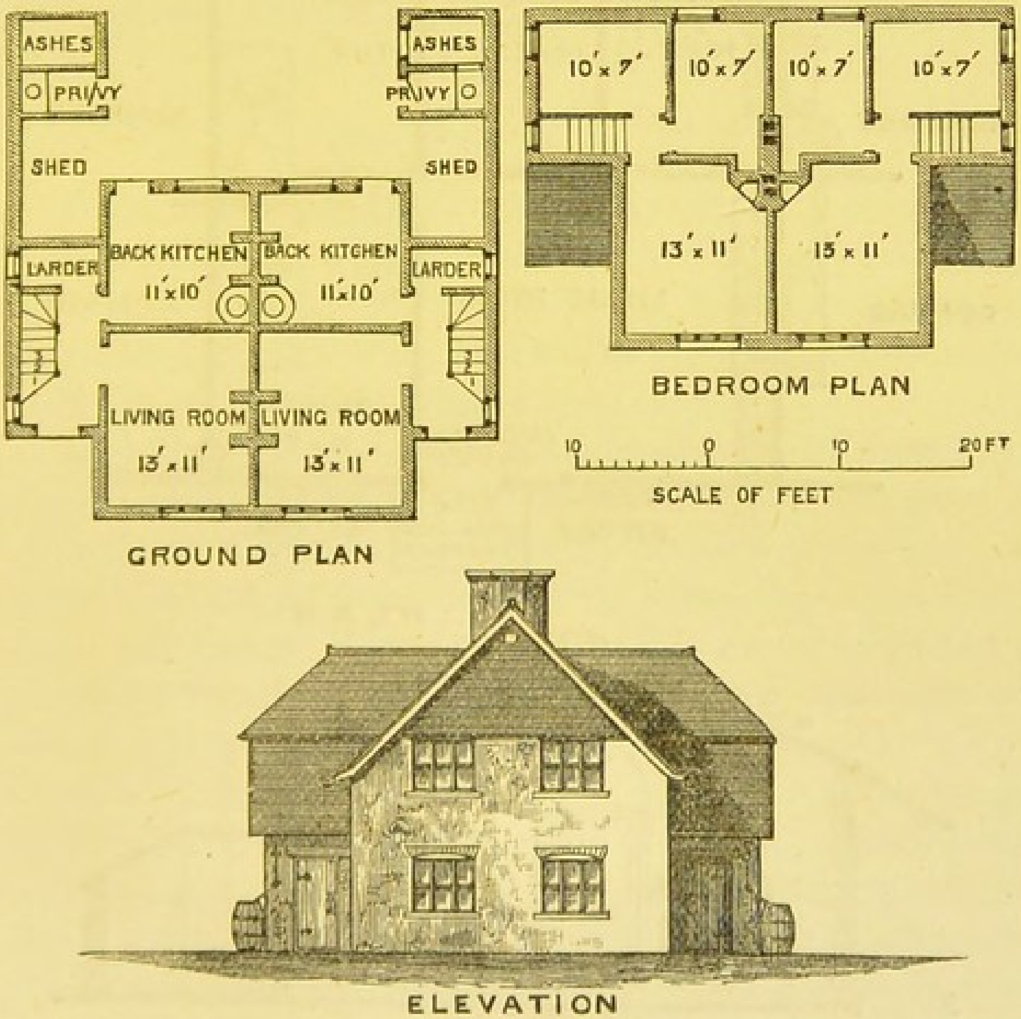
ELEVATION OF OFFICE

COTTAGE NO. 2.

can be, and might cost for the pair about £300; exclusive of fencing and water-supply, which may add 10 per cent.

One other modification of what I venture to call here the standard cottage is added, because, though these modifications are not considerable, they help to draw attention to the small difference which may add to, or detract from, the comfort of those houses of the poor, and at the same time make but little change either in the cost or general appearance of the dwelling.

In this case the living room has only one door, that, namely, into the porch, which contains also the staircase.

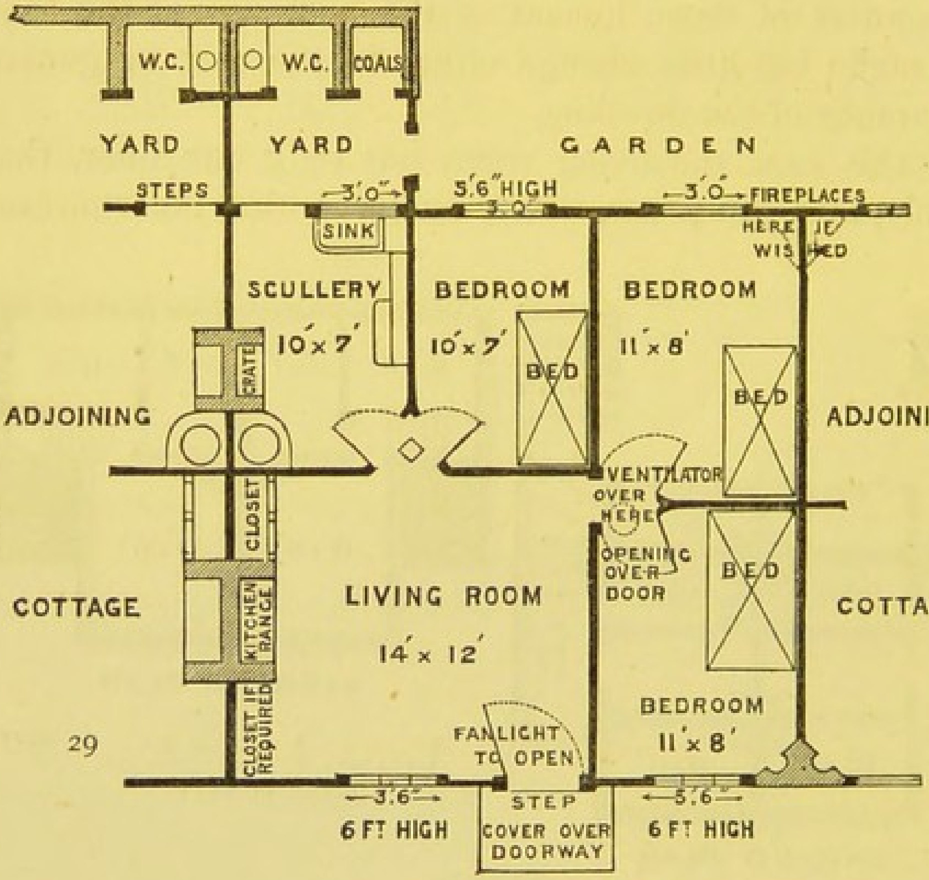

ASHES
PRIVY
SHED
LARDER
BACK KITCHEN
11'x10'
LIVING ROOM
13'x11'
ASHES
PRIVY
SHED
LARDER
BACK KITCHEN
11'x10'
LIVING ROOM
13'x11'
GROUND PLAN
10'x7'
10'x7'
10'x7'
10'x7'
13'x11'
13'x11'
BEDROOM PLAN
10
0
10
20 FT
SCALE OF FEET
ELEVATION

28.—NO. 3. COTTAGE PROPOSED ON SIR THOMAS ACLAND'S ESTATES.

The back kitchen, or washhouse, is of the same width as the front room, namely, 11 feet. The wood or coal shed is close to the back door, and the closet and ash shed immediately beyond. The cost would be about the same as the standard.

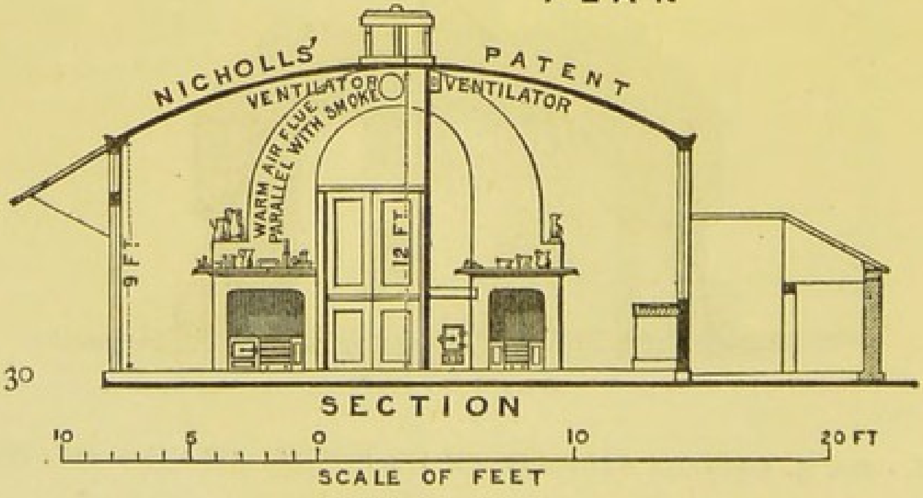
It would not be right, even in so slight a sketch as this paper contains, wholly to omit reference to the many proposals which have been made outside the ordinary range of building operations, such as iron or concrete cottages. The following plan is therefore reproduced from Mr. Chadwick's interesting Report on the Dwellings exhibited in the International Exhibition at Paris in the year 1867. To what extent this kind of construction has

29


W.C.
W.C.
COALS
YARD
YARD
GARDEN
STEPS
3.0
5.6" HIGH
3.0
FIREPLACES HERE IF WISHED
SINK
SCULLERY 10'x 7'
BEDROOM 10'x 7'
BEDROOM 11'x 8'
GRATE
BED
BED
ADJOINING
ADJOINING
VENTILATOR OVER HERE
CLOSET
OPENING OVER DOOR
BED
COTTAGE
KITCHEN RANGE
LIVING ROOM 14' x 12'
COTTAGE
CLOSET IF REQUIRED
FANLIGHT TO OPEN
BEDROOM 11'x 8'
3.6
6 FT HIGH
STEP
COVER OVER DOORWAY
5.6
6 FT HIGH

PLAN

30


NICHOLLS' PATENT
VENTILATOR
VENTILATOR
VENTILATOR
WARM AIR FLUE PARALLEL WITH SMOKE
9 FT.
12 FT.

SECTION

10
5
0
10
20 FT
SCALE OF FEET

OCCASIONAL COTTAGE.

found favour I am not able to say. The arrangements are ingenious, and the cost, when constructed of the wire, wattle and cement material proposed by Mr. Nicoll, is said to be not more than £60. This includes living room and scullery, and three bedrooms, with kitchen range, copper, and latrine. All have larger floor space than the types which have been above described. This plan is here inserted, not so much for the purpose of recommending it, as for suggesting the application of ingenuity to the construction of the class of dwellings which may not be required to be so lasting as well-built cottages, and which yet should be healthy as long as they are required, and can be quickly built and easily removed.

2.—WATER-SUPPLY.

There are three modes of Water-Supply for a single cottage as for the village. 1st, by rainfall and tanks; 2nd, by wells; 3rd, by conducted water. The first point to be ensured in all cases relates to the quality; the second as to the quantity obtainable.

As to the quality—1st, rain water as received in a rural district may be counted to be pure and "good for use." In many level districts it is necessary to carefully collect and store it in tanks, great care being taken as to the receptacle for storage. The quantity that can be obtained in England varies greatly between the west and east, and where it is most wanted the least is to be obtained. In the Nene level the case is becoming urgent, as I am informed by Mr. Wing, the Duke of Bedford's auditor. An average cottage may yield perhaps an average of 2 gallons per head a day, or nearly 3000 gallons annual, excluding loss by evaporation. A storage tank of 4000 gallons is not a great affair, but not to be lightly proposed. No owner of cottage property would willingly rely now on this source. Thatched roofs and lead gutters are not to be employed.

Whenever there is an adequate fall in the district, the superfluous rain gravitates to the nearest brook, after having been caught at the cottage itself so as to keep full a large water-butt, or a cistern in the kitchen.

2nd. *The supply by wells.*—No data *generally* applicable to the very various geological conditions of England can be given. Local experience is generally adequate. The shallow wells, which are those commonly found in single cottages and in villages, are always liable to contamination from surface water, and such contamination is seldom absent. In agricultural districts such water has the double risk of contamination from surface manure, and from the excreta from the house. As a general rule, a cesspool and a well should not exist on the same premises, though in some strata such prohibition may not be necessary.

The chief Officer of Health should be able to supply the details of Well construction.

3rd. *Conveyed water* may be conducted to villages and cottages either by natural streams or rivers, or artificially as in towns. This mode of supply is that almost wholly relied upon in all the hill countries of the West of England, of Wales, and of Scotland. In the flatter districts of the Midland and Eastern Counties, both streams and rivers are less frequently the natural source of supply, even of the villages. In some places they have ceased to be safe. This subject requires further scientific investigation.

It is an error to suppose that the beautiful rivulets which we see in the hill country are all pure. Not infrequently, the cottage below the farm receives the bright draught contaminated by the farmyard above; just as many rivers have, as all know, "previous sewage contamination." All such sources of water-supply have to be considered locally, and in cases of doubt, referred to the public analyst through the medical officer of health. In rivulets from hill districts it is easy, at the cost of a few shillings, to arrange a miniature filter-bed on the stream above the cottage.

These observations are necessarily of the most perfunctory kind. The Public Health Water Act of 1878 has made such stringent provision in respect of the water-supply of villages and cottages, that there is nothing to be added in the way of legal *power* to obtain whatever water arrangements the district admits.

Will may be wanting—and in that case the breakdown of all organisation is certain, if the will be absent in a vital part of the machinery. Inspectors of nuisances if well instructed, medical officers of health if trained by general and by scientific education, and the sanitary authorities if wisely chosen by an intelligent constituency, have together an instrument of precision in the Health Laws of this country, which should greatly protect us even against the germs of the period. Perhaps we expect too certain immunity in an order of things in which "Change and decay in all around we see," and in which the law of progress means also the necessity of death.

The valuable House of Commons Report on Water (1876), which led to the Public Health Amendment Act (1878), contains together with its evidence a full account of many of the difficulties of village administration. It illustrates with great force the necessity of a strong central authority, which should, however, interfere as little as possible in local details, save in the way of Instruction and Report. As regards the actual question of Water-supply for villages, it is very tersely stated in a paper by Mr. R. H. Paget at pp. 184–188 of the Report here referred to. The principles there explained are virtually carried out by the Act just named. In this Act it is laid down that it is the duty of every Rural Sanitary Authority to see that every occupied dwelling-house within its district has within a reasonable distance an available supply of wholesome water sufficient for the consumption and use for domestic purposes of the inmates of the house. Provisions are duly made for throwing the costs of this supply on the owner of the house, or on the district, as the case may be. It may happen that it is impracticable to provide the supply at a reasonable cost; or it may happen that the only available supply is so situated that it is out of the power of the owner to obtain it; and that for these and other reasons the expense should be borne by the district.

These exceptional circumstances are usually well understood in the localities; but as was shown to the Parliamentary Committee (p. 189), instances may and do occur where the local authority, or the majority of it, is indisposed from local reasons to act with justice on the facts. There is probably no single factor in Rural Health arrangements more complicated by numerous interests, requiring more care, or calling for more sound judgment, than this one of the regulation of the Water-supply in relation to village health and comfort.

3.—REMOVAL OF REFUSE.

The refuse to be removed from a single cottage unit or from an aggregation of cottages is the same in kind as that from a town, excluding the products of manufactures. The principle of its disposal is, however, in some respects, not the same.

It consists of five portions: the rain water; the surface water; the house refuse, *i.e.* washings; the ashes; the excreta.

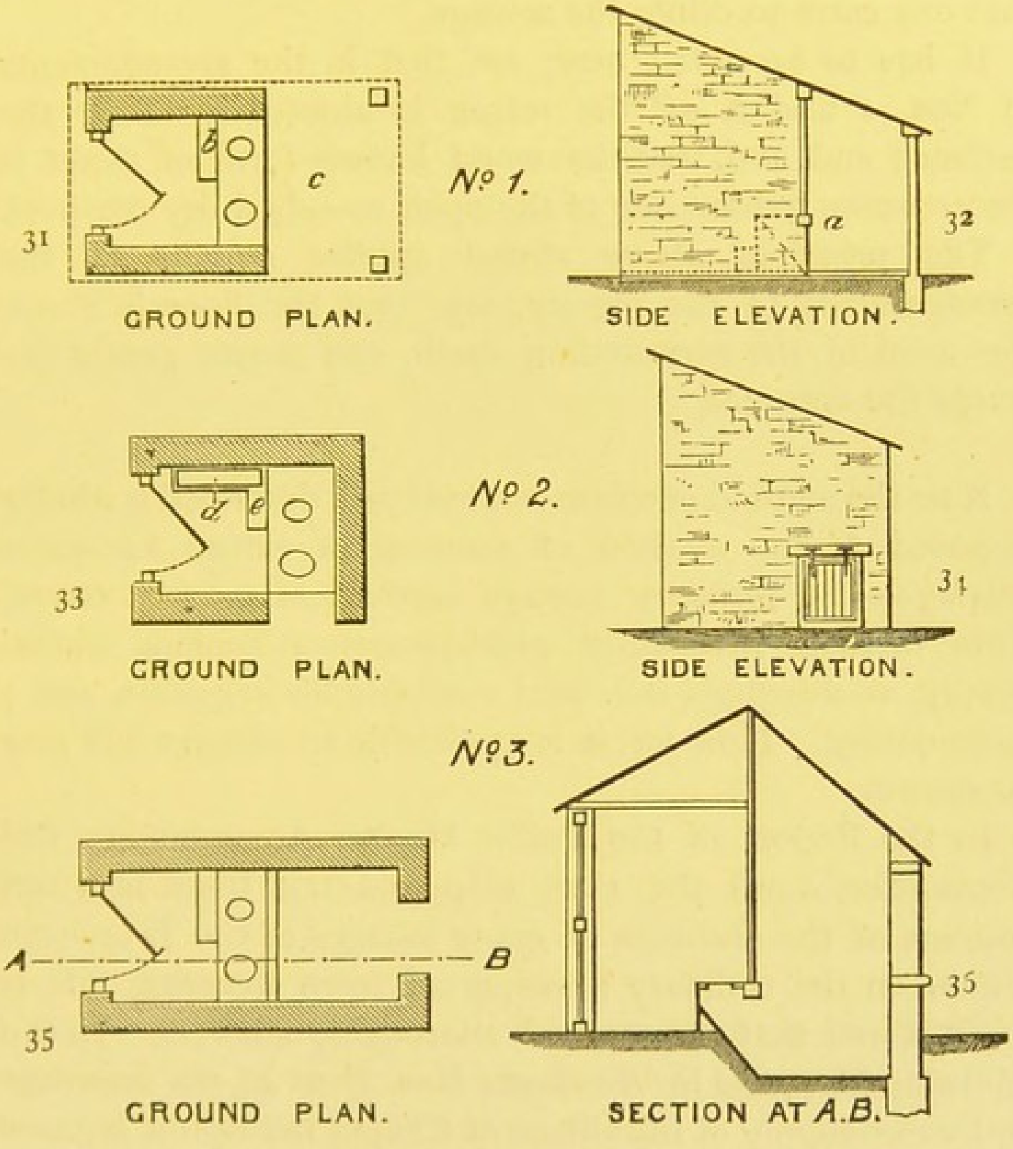
The water has to be partly stored and partly removed to the nearest brooks.

The house refuse, the ashes, and the excreta, go to the garden or the allotment, or the farm.

The following general arrangements seem to be desirable:

There is to be no private closet under the cottage roof. The *washings* are to be emptied into a sink, which communicates directly with either a small trap, through a grating (the pipe being disconnected with the trap), or, if there be a sufficient fall, to a garden, by an open gutter, or open tile drain leading thereto. The ashes and the human excreta are mixed together, and removed by the agency of one or other form of "Earth Closet," taking that term generally for an apparatus which is not a cesspool, and which has to be frequently emptied of its contents in a more or less dry state, and which is wholly above ground.

The annexed woodcut shows a good arrangement, in which the principles are carried out in the simplest manner. They are these:


No 1.
c
b
31
GROUND PLAN.
a
32
SIDE ELEVATION.
No 2.
d
e
33
GROUND PLAN.
34
SIDE ELEVATION.
No 3.
A
B
35
GROUND PLAN.
35
SECTION AT A.B.

SIMPLE ASH OR EARTH COTTAGE-CLOSETS USED IN THE WEST OF ENGLAND.

a. Seat joist.
b. Step.
c. Covered flat; open.
d. Dry earth; flat enclosed.
No. 3. Sunk receptacle, concrete and cement; water-tight.

1st. All the human excreta, and no other refuse, are deposited in it, with the frequent daily addition of either dry earth or ashes.

2nd. The ashes are applied, on *every occasion*, by raising the cover on its hinges.

3rd. A sloping slate or slab directs all contents, either to a slightly inclined stone or concrete floor, which ought to be above the level of the surrounding ground; *or* into a receiving tank on low wheels. This mixture is conveyed to the garden, or to the earth somewhere, once or twice in every week.

The rear of the closets is protected by a roof whereby no rain can enter to dilute the sewage.

It has to be noted here, 1st, that in the arrangements of Nos. 1 and 2, *all* the refuse is absolutely above the surface; and 2nd, that the worst known form of closet is the common garden one of the open, so-called dry cesspool.

The principle above stated applies equally to the arrangements of the pig-sty, viz., that the floor is above the level of the surrounding earth, and slopes gently towards the entrance.

Now the method of refuse removal just described is wholly opposed to the method of removal of refuse by water carriage—the ordinary sewage method of modern towns. This method practically presupposes a copious water-supply, an adequate fall, land available for irrigation, and a large outlay. How far it is applicable to villages will now be shown.

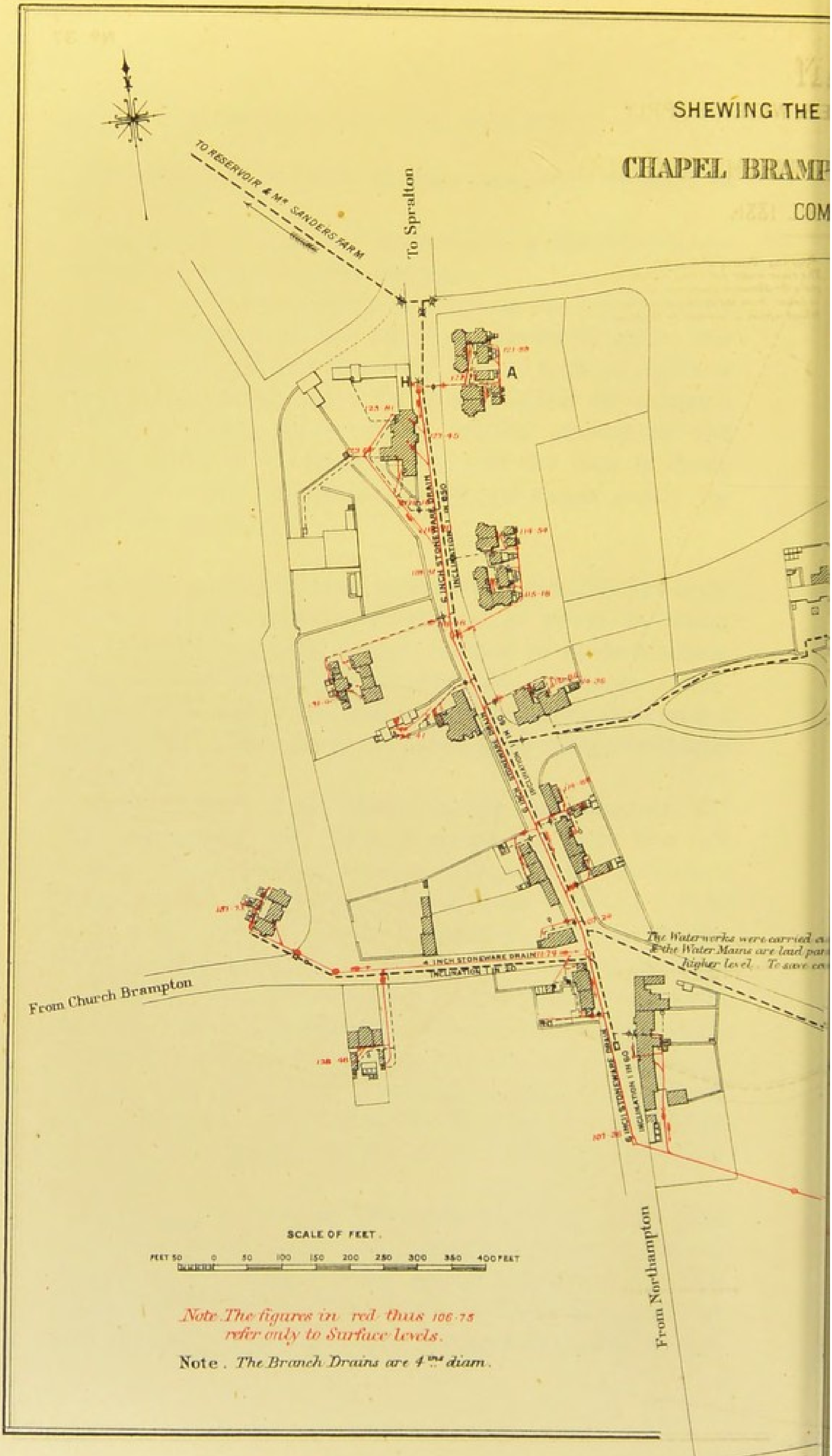
In the Report of the Public Health Amendments Bill Committee, April 5th, 1878, at pp. 92–104, there is a full account of the drainage of many villages in the Brixworth Union on the ordinary principle of town sewering. It is there stated that the method thoroughly answers. In the following Map, and in Woodcuts Nos. 37 to 44, the sewerage and water-supply of the village of Chapel Brampton, is given in detail. It is the best instance with which I am acquainted, where the modern methods of sewers and water-supply are complete as applied to a straggling rural village. It was executed for His Excellency Earl Spencer, now Lord Lieutenant of Ireland, by Mr. E. F. Griffith, his Sanitary Engineer.

The village of Chapel Brampton is distant about four miles from Northampton. It is situated on the River Nene, and stands on a slope about eighty feet above it. The stratum on which the village stands is chiefly ironstone, but near the river it is clay. The arrangements, both in con-

SHEWING THE

CHAPEL BRAMP

COM


TO RESERVOIR & Mr SANDERS FARM
To Spralton
A
H
6 INCH STONEWARE DRAIN
INCLINATION 1 IN 250
121·89
125·81
119·54
115·18
4 INCH STONEWARE DRAIN
INCLINATION 1 IN 25
From Church Brampton
138·98
6 INCH STONEWARE DRAIN
INCLINATION 1 IN 90
101·28
From Northampton
SCALE OF FEET.
FEET 50 0 50 100 150 200 250 300 350 400 FEET

The Waterworks were carried
& the Water Mains are laid par
higher level. To save co

Note. The figures in red thus 106·75 refer only to Surface levels.

Note. *The Branch Drains are 4ins diam.*

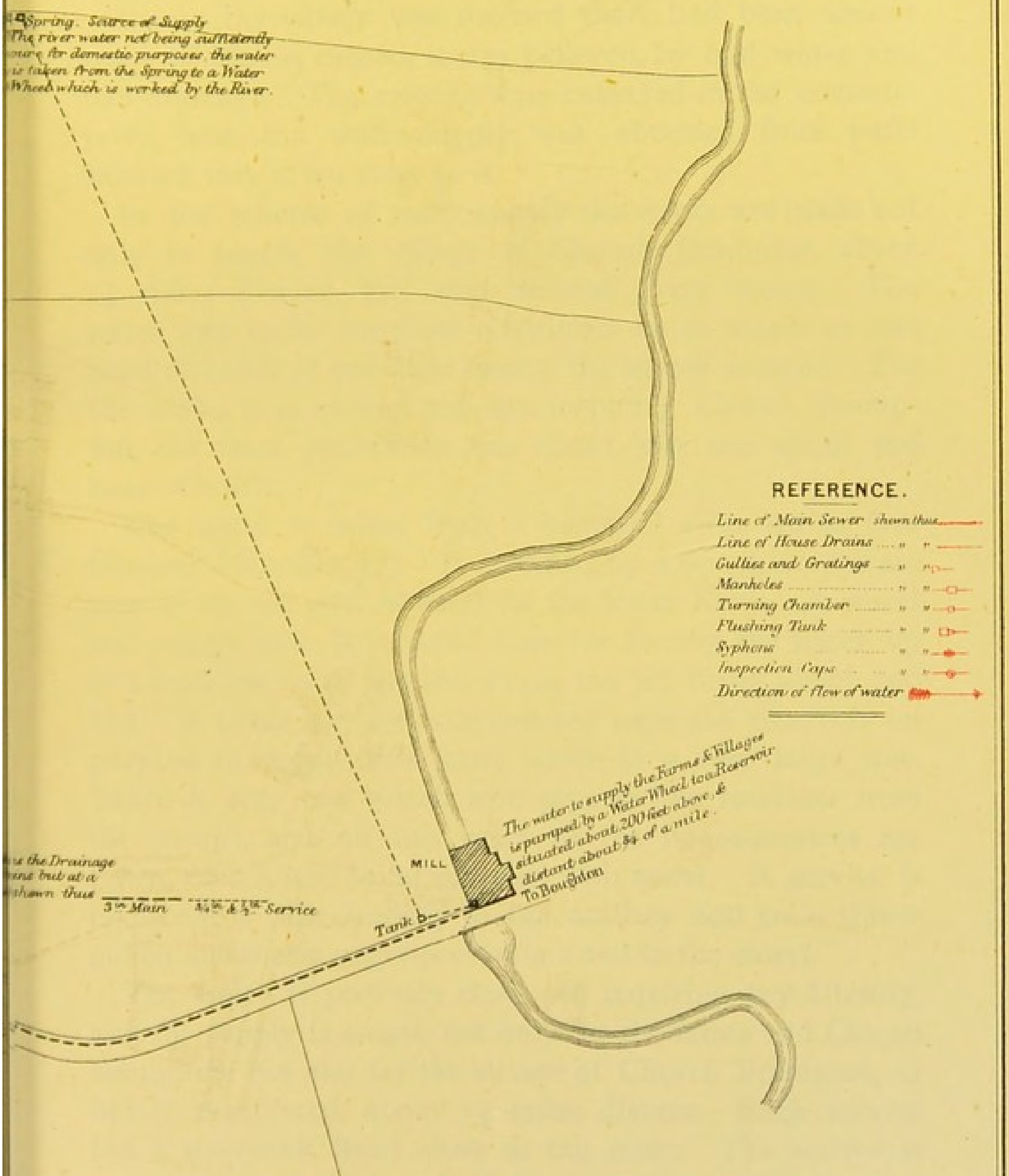
Nº 37.

N

& WATER SUPPLY

RTHAMPTONSHIRE.

RIL 1881.



Spring. Source of Supply
The river water not being sufficiently
pure for domestic purposes the water
is taken from the Spring to a Water
Wheel which is worked by the River.

The water to supply the Farms & Villages
is pumped by a Water Wheel to a Reservoir
situated about 200 feet above, &
distant about ¾ of a mile.

s the Drainage
ens but at a
shown thus
3in Main ¾in & ½in Service

REFERENCE.

Line of Main Sewer shown thus
Line of House Drains .... " "
Gullies and Gratings .... " "
Manholes .... " "
Turning Chamber .... " "
Flushing Tank .... " "
Syphons .... " "
Inspection Caps .... " "
Direction of flow of water

nection with the drainage and water-supply, are of the simplest kind, and will be readily understood from the various diagrams.

Before the village was drained there had been serious cases of illness, caused, it was believed, by bad water and bad drainage. The excreta were collected in the common privy, and the water-supply was obtained from wells situated very often close to it.

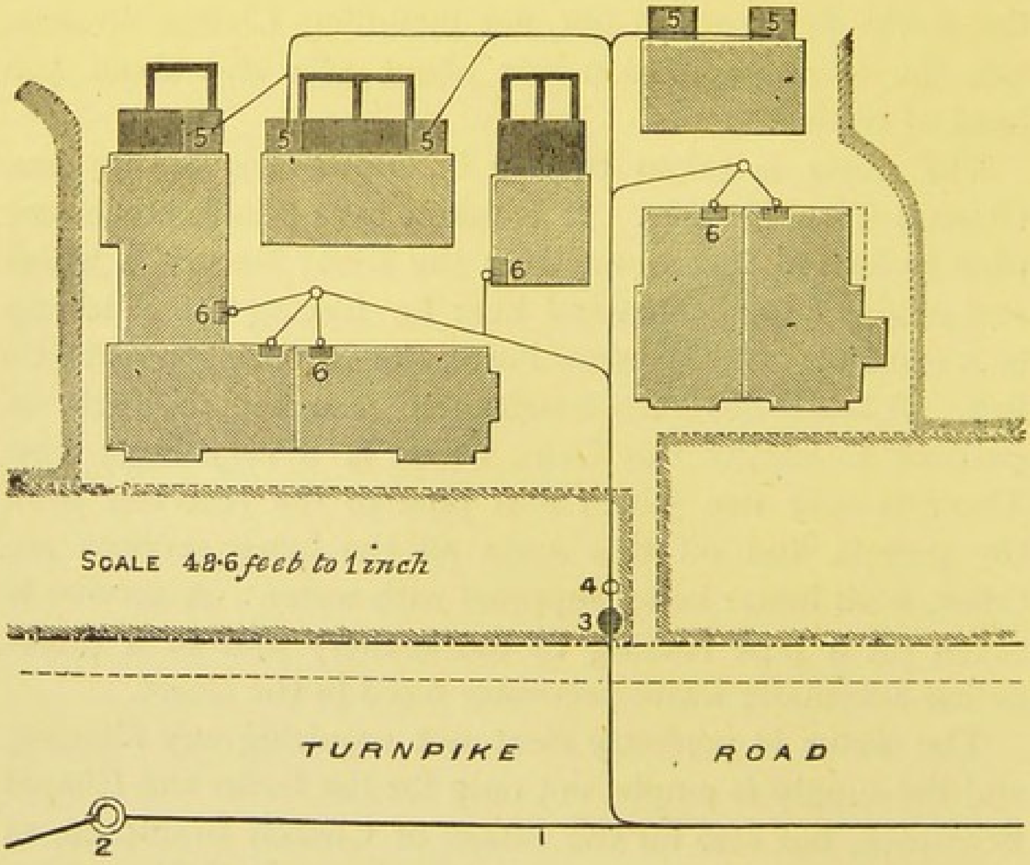
In the scheme of water-supply the works are made not only to supply the village of Church Brampton, about 1½ miles distant, but also several large farms. The water had to be supplied sometimes to as many as 200 head of cattle at one farm during the winter months. For the works first carried out, not including Church Brampton, the total population was about 360, and about 500 head of cattle.

The water is taken from a beautiful clear spring (see General Plan, No. 37). It is taken by a 6-inch stoneware pipe to an old mill situated on the River Nene. A wheel and pumps have been fixed here for forcing the water up to a reservoir near Sanders Farm, the lift being about 200 feet. A tower has been constructed near the reservoir on purpose to supply this farm, which is a very large one. There is only one 3-inch iron pipe to the reservoir from the pumps, and off this main all the house-services are taken, each house being supplied with water. A service is taken off a pipe leading to the scullery and to a three-gallon automatic waste-preventer fixed in the closet.

The water is perfectly clear, not requiring any filtering, and the supply is ample, not only for the farms and Chapel Brampton, but also for the village of Church Brampton, as before mentioned, about 1½ miles distant. Each service has a stop-cock fixed close to the main. The service is constant, as when the wheel is not working, the reservoir situated at Sanders Farm is made sufficiently large for three days' supply. There are no particular remarks to be made with regard to the water-supply, excepting two; of these the first is very important.

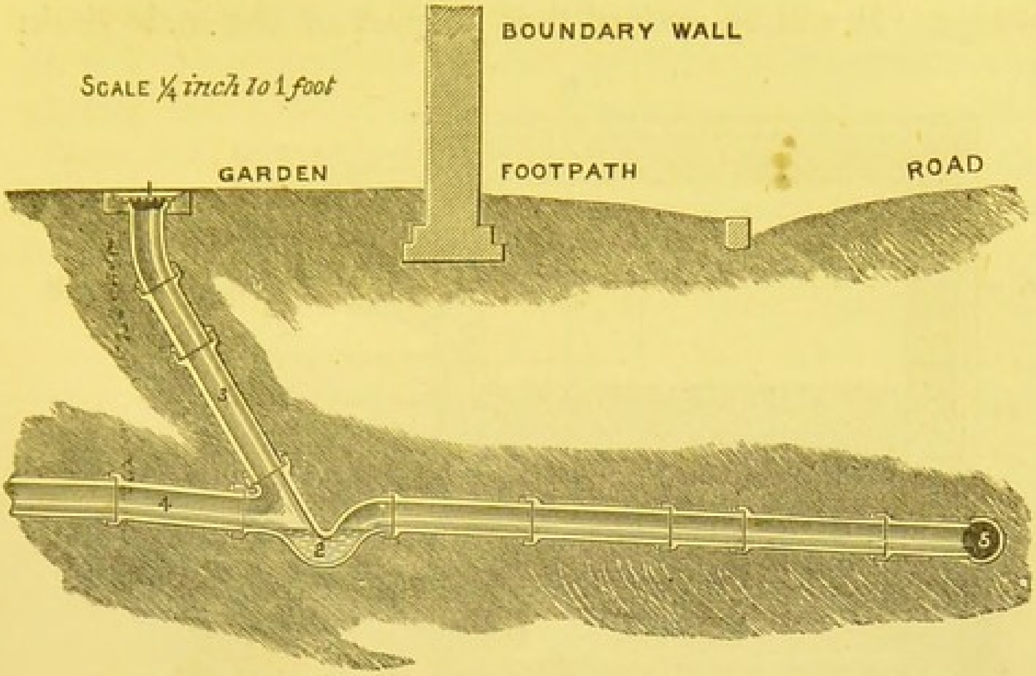
To each of the cottages a garden is attached, and in a dry summer the whole of the evening is occupied by the tenants in watering the gardens. The consequence is that the amount of water used, it being a constant service, is enormous as compared with the population. The next difficulty is with regard to the waste-preventers and frost; the closets being fixed outside in the garden, the waste-preventers are liable to freeze, especially as it is very difficult to get country people to pay attention to the means proper to provide against this difficulty.

As regards the drainage, every house in the village has been completely drained. The main drainage, which consists of a 6-inch stoneware pipe, is taken all on to an osier-bed, situated in a hollow some little way from the



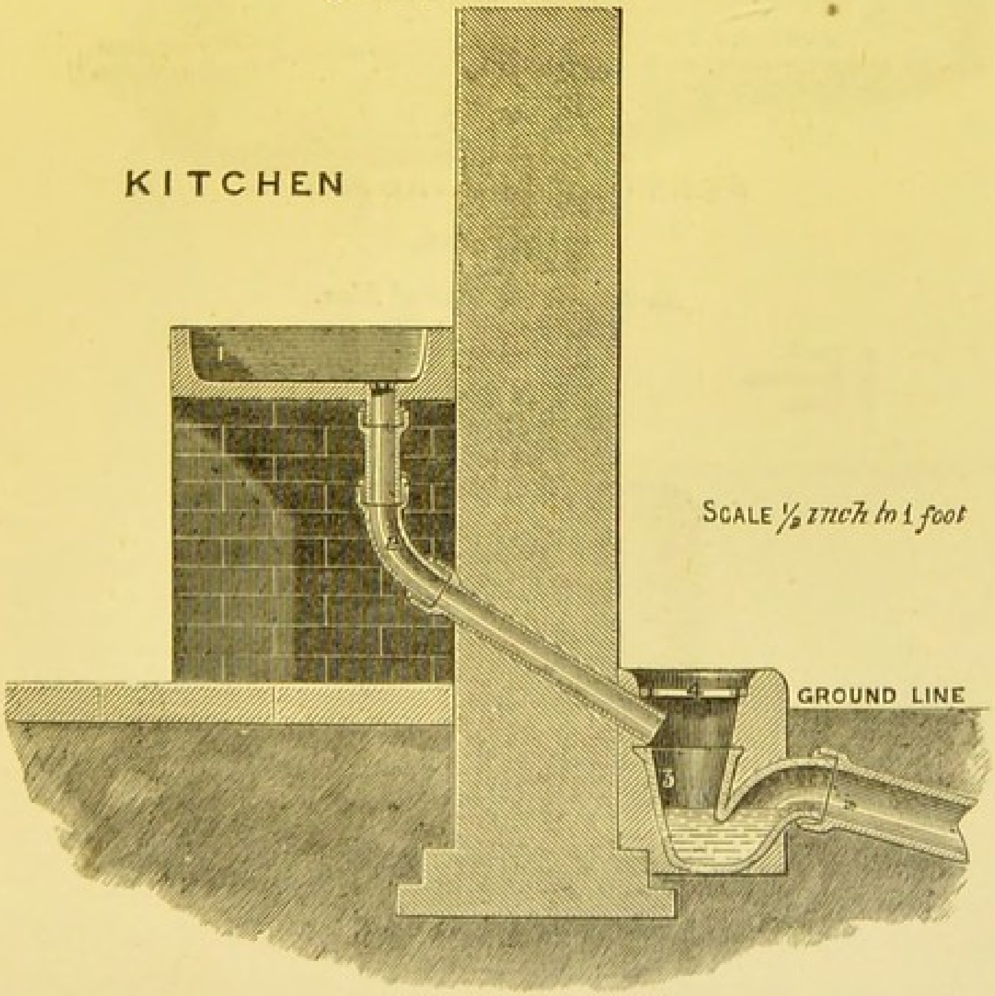
38.—DRAINAGE OF BLOCK PLAN OF FIVE COTTAGES.

1. Main Sewer.
2. Manhole.
3. House Disconnection (See plate 39).
4. Ventilator.
5. Water Closets (See plate 44).
6. Sinks (See plate 40).


BOUNDARY WALL
SCALE ¼ inch to 1 foot
GARDEN
FOOTPATH
ROAD
1
2
3
4
5

39.—METHOD OF DISCONNECTING HOUSE DRAIN FROM SEWER.

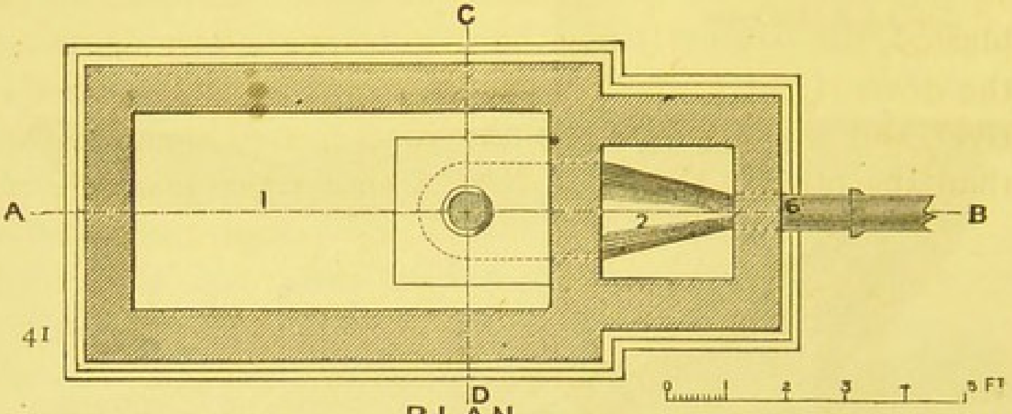
1. Removable Iron Ventilating grating.
2. 4-inch Syphon Trap.
3. 4-inch Ventilating Pipe.
4. House Drain 4-inch diam.
5. Main Sewer 6-inch diam.


KITCHEN
SCALE ½ inch to 1 foot
GROUND LINE
1
2
3
4

40.—DISCONNECTION OF SINK.

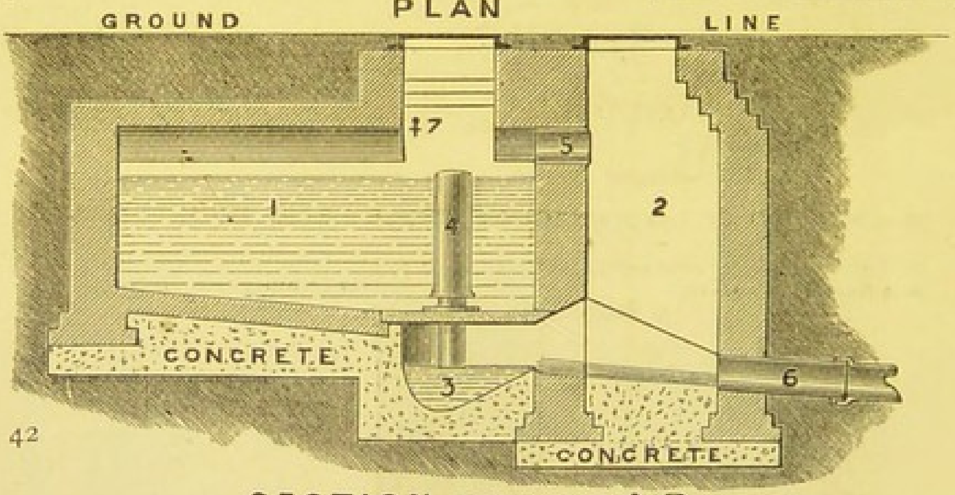
1. Stoneware Sink.
2. 2-inch Stoneware Waste Pipe.
3. Stoneware Gully.
4. Iron Grating.

village. It will be noticed that no part of the main drain


C
A
1
2
6
B
D
0 1 2 3 4 5 FT

41

PLAN


GROUND LINE
7
5
1
4
2
CONCRETE
3
6
CONCRETE

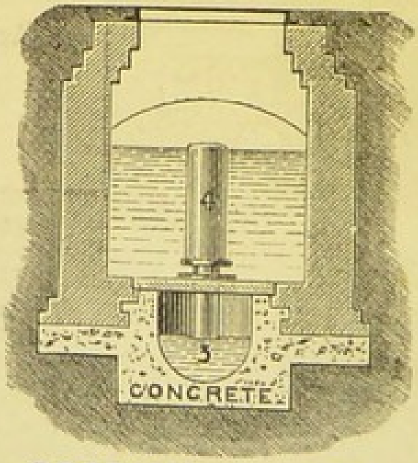
42

SECTION ON LINE A-B

FLUSH TANK.

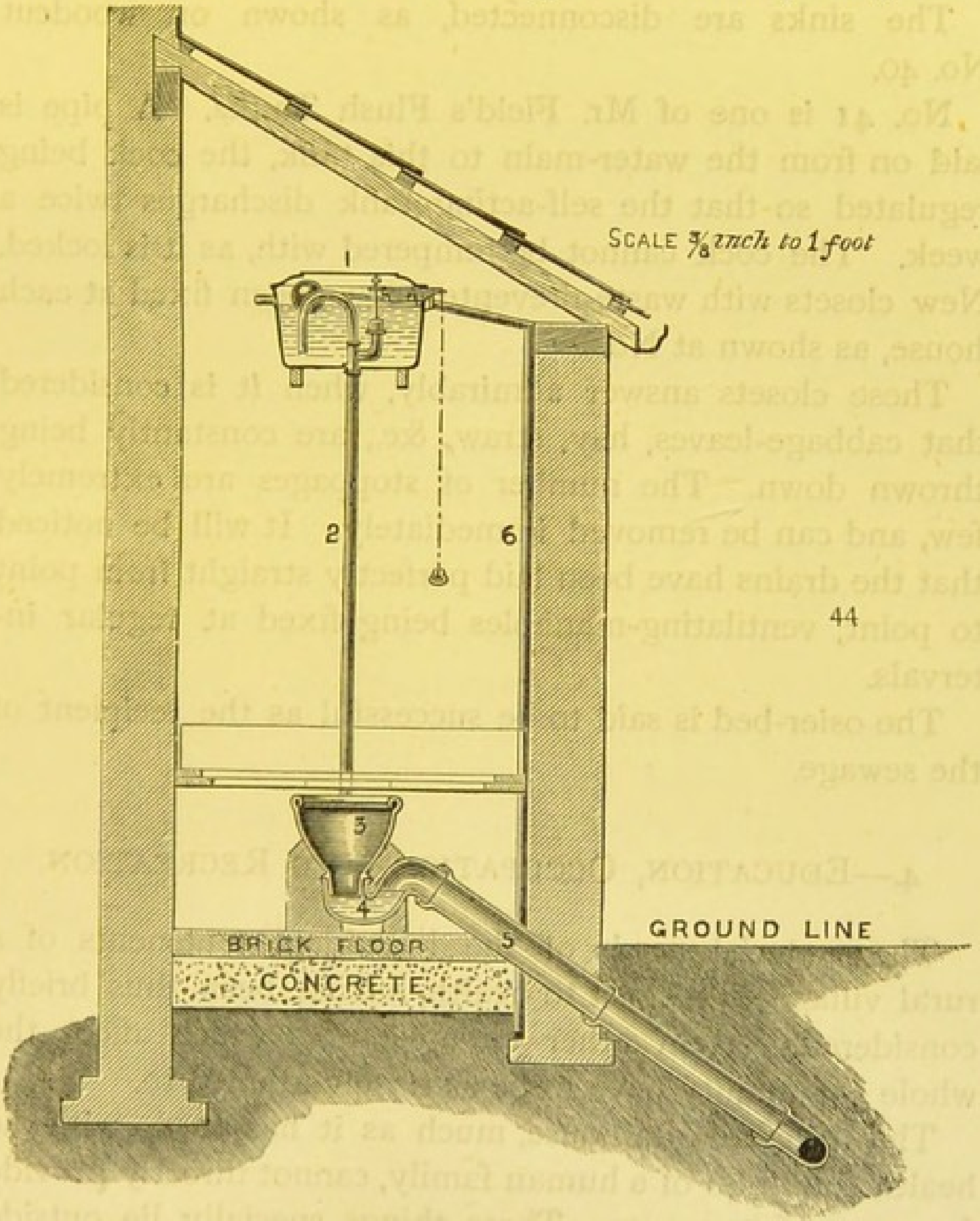
See letter H on general Plan.

1. Tank.
2. Manhole.
3. Trap.
4. Field's Automatic Syphon.
5. 6-inch Overflow.
6. 6-inch Stoneware Drain.
7. Supply Cock.


4
3
CONCRETE

SECTION THRO' C-D

is laid to a fall of less than 1 in 60, and that all the house-drains are laid to a fall of not less than 1 in 40. The drain along the main road is of considerable depth, being about 13 feet deep; and the greater portion of this had to be blasted, the stratum being hard ironstone. The depth of the drain is due to the fact that the land slopes towards the river, and that one part of the road is very much higher than the other. Woodcut No. 38 shows the principle on which each block is drained. Nos. 3 and 4 on woodcut 38 correspond with the method of disconnecting the house-



44.—CLOSET—METHOD OF FIXING HOPPER BASIN WITH WASTE PREVENTER.

1. Automatic Waste Preventer.
2. 1¼-inch Service Pipe.
3. Sharpe Cottage Basin.
4. Stoneware Trap.
5. 4-inch Stoneware Drain.
6. Service to Cistern.

drain shown on No. 39. The advantage of this form of disconnexion is, that if the Syphon No. 2 (see woodcut 39) becomes choked, it can be cleansed by removing the grating at No. 1 and passing a rod down to the syphon.

By examination of the woodcuts, it will be seen how the several disconnexions are effected.

The sinks are disconnected, as shown on woodcut No. 40.

No. 41 is one of Mr. Field's Flush Tanks. A pipe is laid on from the water-main to this tank, the cock being regulated so that the self-acting tank discharges twice a week. The cock cannot be tampered with, as it is locked. New closets with waste-preventers have been fixed at each house, as shown at No. 44.

These closets answer admirably, when it is considered that cabbage-leaves, hay, straw, &c., are constantly being thrown down. The number of stoppages are extremely few, and can be removed immediately. It will be noticed that the drains have been laid perfectly straight from point to point, ventilating-manholes being fixed at regular intervals.

The osier-bed is said to be successful as the recipient of the sewage.

4.—EDUCATION, OCCUPATION, AND RECREATION.

The material needs of the individual tenements of a rural village, in respect to health, having been thus briefly considered, certain other circumstances which affect the whole community have to be as tersely alluded to.

The structure of a house, much as it has to do with the health condition of a human family, cannot directly provide for many of its wants. Three things specially lie outside its province. (1st) Education, (2nd) Occupation, (3rd) Recreation. On each of these a few words must be said, and but a few.

And first as to *Education.*

Although it is certain that the bad dwellings conduce to every form of vice and misery, physical and mental, yet some of the meanest hovels are found within to be models of order and neatness. I have seen a widow, hardly maintaining herself by unceasing work with her needle, or with the laborious pillow for lace, with the fabric of her hut as bad as the hovel of the Hares, the floor bare earth, the roof but rugged poles and scanty thatch, yet all her little store as orderly as though it were in a palace. And I remember the saying of such an one. "They talk, sir, of putting me in a better house. Promise me I shall not leave this but in my coffin. Here my children were born and taught; here they and their father died. Oh, let me too follow the same road." How is this? It is simply the result of personal character! And what is personal character? The development of the higher moral nature through self-sacrifice, self-mastery, and generally through suffering. And self-sacrifice with suffering has given peace to human souls under every condition of development from pole to pole since the Race began, and will be so till the mysterious destiny of the Race has been fulfilled. This being so, I shall say little on Education. "L'Hygiène c'est LA MORALITÉ et L'AISANCE." Education is the just development of the whole faculties, with special attainment and knowledge according to the conditions. It has hitherto been mainly associated with religious teaching. A swing of the pendulum of thought seems now to point only to training by the faculties of observation and by logic, which lie at the root of Science. Dilute science appears to some minds to be the key to the formation of character. "And a knowledge of the Vertebrata," I once heard said at a public meeting, "and the still more weighty privilege and responsibility of children in comprehending the Invertebrata," seem to some to be the only methods calculated to train the infant mind the way it should grow, rather than obedience to parents, cheerfulness, unselfishness, reverence, and industry. But be this as it may, it may be assumed that the health of the Village will depend in large measure on the possession of the moral qualities exhibited in some form by all great souls, howsoever obtained, and in what way soever applied, as the popular poet sings—

> Lives of great men all remind us
> We may make our lives sublime,
> And departing leave behind us
> Footprints in the sands of time.

Experience has shown that, on the whole, wretched habitations are incompatible with such elevation.

The Village School then, and the Village Church—interpret " School " and " Church " as you will—are essential to the development of Village Health. Without an intelligent and an orderly population you will not have a clean or healthy one. Without the " School " for the head, and the "Church" in the heart, are neither knowledge nor wisdom in the child.

And now a few thoughts upon *Occupation* and *Recreation*.

I have written the above words together with some reluctance. To the ordinary poet Village Life is one that suggests healthy occupation, and the warm delight of simple ways. And so it is, for those who have steady work, regular wages, happy homes, healthy families, and good masters. I know no happier life for a contented and unambitious soul, who lives in the strong faith of a Christian man, upon the estate of a true gentleman, who takes care of him, as soon as he is past work, as of a faithful friend.

Of the millions of labourers "who go forth to their work, and to their labour until the evening," to what number does this description apply? This question is harder now to answer than it was. But I put the two ideas of occupation and recreation together, because they are essentially correlative. The recreation, if we describe it as of a yeoman with a moderate farm, is not the same as that of a labourer. Many a small yeoman leads, or did, fifty years ago, lead in England a more anxious and precarious life than a modern steady and good farm-labourer in a permanent place.

What Colonel Waring, engineer, soldier, philanthropist, says of "slate-and-pencil farming" in Massachusetts is most true of the small English farmer. "Ten acres of land can be ploughed, manured, and planted with corn, and the crop can be well cultivated and harvested for so many dollars. Such land with such manuring and cultivation may be trusted to yield so many bushels of corn to the acre; and, after making due allowance for chance, the balance of the calculation shows a snug profit. In like manner we may figure out a corresponding return from the hay-fields, from the root-crops, from two or three acres of potatoes, and from a patch of garden-truck for which the neighbouring village will furnish a good market. Then the poultry will return a profitable income in eggs and in 'broilers;' and altogether it is easy for an enthusiastic person to show how interest on invested capital and good compensation for labour are to be secured in agriculture.

"But when the test of practice is applied to our well-studied and proven scheme; when we see how far our allowance for 'chances' has fallen below what is needed to cover the contingencies of late springs, dry summers, early frosts, grass-hoppers, wire-worms, Colorado beetles, midge, weevil, pip, murrain, garget, milk-fever, potato-rot, oats-rust, winter-killing, and all the rest; when we learn the degree of vigilance needed to keep every minute of hired labour and team-work effectively employed; and when we come finally to the items of low markets and bad debts,—we shall see how far these and similar drawbacks have undone our arithmetic, and how often our well-contrived balance must be taken into the footings of the other column of figures.

"In nearly every other occupation than farming, the hardest worker finds a daily relief from his toil, and from the suggestion of toil, in a home that is entirely apart from his industry. However arduous and anxious and long-continued the work, there comes a time when it is laid aside, and when the workman goes into a new sphere, where the atmosphere is entirely changed. His home is a place of rest and pleasure, or at least a place of change. The pen and the hammer are left in the counting-room and in the shop ; and, however far the home may fall below his desires and ambition, it is at least free from the cares of the day's occupation."

Any one conversant with the detail of a small farmer's life knows how absolutely true this is. It is a life of unceasing toil, in all weathers, under every circumstance of success or disappointment alike, and one perpetual struggle with details which he cannot by any foresight influence. It is not my part to draw a comparison with other forms of life. Nor will I here say anything of the personal family history of the farmer with large capital, its risks, its successes, its skill. The steady labourer has another form of trial. It is one of weekly care. His health is his daily income. His income has no increase, variation or elasticity. It is the least on which he can live. And it is hardly won. What are his means of Recreation out of hours of toil? There seems to me to be mainly three. Chiefest of all, the peace of the Sabbath-day. Next, outside his home, his Allotment, and his garden, objects of personal interest and personal ambition ; and thirdly, his Village club. A treatise may be written on each of these, and nothing new then said. Each must be insisted on. An allotment is counted now almost a necessity for an agricultural labourer, and not to have it a misfortune and a waste. It may vary in size from the eighth of an acre to three or four acres.

The argument for co-operation, in allotments on a small scale, is becoming almost unanswerable. There is a parish in the Midland Counties where there were, twenty-five years ago, thirty cows—and now not five. In the days of commons many small proprietors had cows. Now none can keep them ; and, moreover, in very many grass parishes not a drop of milk can be bought. All the milk goes for the supply of the great towns. The children never taste it. This may become a great evil by weakening the stamina of the rural population. Cow co-operation is not easy, but is possible. But herein political and economical questions enter, and so I pause. Here we deal with questions of Health. The allotment, if near, insures for the labourer careful use of the refuse from his home. It adds thus to his enjoyment, his kitchen, and his purse, and so to his Health.

Of these three factors of Recreation here named, the most that need now be said is of the Village Club. And here we have the great authority of Sir John Lawes. I propose to quote these words which he has kindly sent to me :—

"It will probably be asked, What are the benefits which the parish has derived from this club, and what inducements it holds out to others who contemplate the establishment of a somewhat similar institution? As a substitute for the public-house, it possesses many advantages. A man can hardly go into a public-house, and occupy a seat for the evening without also drinking beer there, for the publican must be paid in some way for providing fire and candles; whereas at the club no one is expected to drink, each member acting entirely in accordance with his own inclination. In villages where there are several public-houses, it is well known that each has its regular customers, and some houses have a bad reputation with the police; petty thefts, and even worse crimes, being often developed where small parties of men are frequently meeting. In a club of any size (Rothamsted has about 180 members) such things are impossible. Those who consider all public-houses an evil, and all drinking of alcohol in any form, and in whatever moderation, an unmitigated curse, are not likely to give any encouragement to an institution which has for one of its main objects the supply of beer to its members. As, however, we cannot prevent drinking, it appears to me desirable that we should endeavour to lessen and arrest some of the evils attendant upon it. If any one will picture to himself the limited accommodation of a labourer's cottage on a winter's evening, with one small fire entirely surrounded by his wife and children, he will hardly blame the man who seeks warmth, quiet, and the society of his fellow-labourers elsewhere. Some attempt made by me to substitute coffee for beer was not successful. It is true the men drank it, and pronounced it very good, as long as I supplied it gratis, but they could not be persuaded to purchase it as a substitute for their beloved beer. To become a member of the club, it is necessary to possess an allotment-garden, the ordinary size of which is one-eighth of an acre, and the rent five shillings per annum, although some allotments are only half that size. I occasionally give prizes for the best cultivated gardens, and every second year we have a show of vegetables. The men take immense interest in these gardens, and should the Royal Agricultural Society offer a premium for the best set of allotment gardens, we should stand a very fair chance of carrying off the prize.

"At the Annual Dinner, which takes place the first Saturday in June, I have an opportunity of meeting almost all the members of the club, and of discussing subjects of mutual interest; even the delicate one of 'strikes' has not been avoided, and a discussion on the subject, bearing upon the relation between the employers of labour and the labourers, has not in any way altered the friendly feeling between them. The influence of the club upon the moral and religious condition of the members can hardly be discussed in these pages. I think, however, any one who reads over the rules of the club, and considers that they have been formed by a committee elected by the annual vote of every member of the club, and that they are not merely printed rules, but are rigidly enforced, must acknowledge that the members submitting to these rules must have arrived at a position considerably in advance of that generally accorded to the agricultural labourer in this country."

RULES AND REGULATIONS OF THE ROTHAMSTED ALLOTMENT CLUB.

1. Every one elected as a member shall pay one shilling entrance fee; he shall sign his name to the rules, and shall pay one halfpenny weekly to the club, and threepence on the death of any member or his wife.

2. Any person wishing to take an allotment garden, can have his

name written on a board, to be hung up in the club-room, in the following form :—A. B. proposed by C. D., member.

3. When a vacancy occurs in an allotment-garden, the names of the candidates shall be taken in the order they are written on the board, and they shall be voted on at a meeting of the committee.

4. The club shall be managed by a committee of twelve members, who shall hold office for one year ; they shall have power to make rules, and the whole management of the club shall be in their hands.

5. The annual meeting of the club shall take place in the month of June, on which occasion the committee for the succeeding year shall be elected. The members of the committee may be re-elected, but it shall be competent for any member of the club to nominate any other member to serve on the committee. The election to be decided by a majority of votes.

6. Each member to draw the beer in order, according to the number of his allotment ; on failing to do so, a forfeit of one penny to be paid to the club.

7. The member who draws the beer shall be in attendance at the club-room every week-day at six o'clock: if he is not there at a quarter-past six, he shall be fined threepence ; if he does not attend at all he shall be fined sixpence. He is to remain until ten o'clock, but in the event of no member being present at nine o'clock, he may shut up the room at that hour.

8. The member whose turn it is to draw the beer shall receive from the previous member the oath book, sixteen shillings and sixpence, and half a barrel of beer, and shall deliver over these articles to the succeeding member. He shall also pay over to the brewer the sum of sixteen shillings and sixpence, and order half a barrel of beer. Any neglect of this rule shall make him liable to a penalty of five shillings, for which sum he shall be sued in the County Court, as well as for any deficiency in the amount of money entrusted to him.

9. Any member selling beer shall be expelled from the club.

10. Any member giving beer to any one except to his wife and children, or to his brother and sister, will be fined one shilling.

11. Any member drawing beer on a Sunday morning shall be liable to a penalty of one shilling, to be paid to the club.

12. Any member drawing beer after ten o'clock, except on a quarter night, when half an hour longer will be allowed, shall be liable to a penalty of sixpence, to be paid to the club.

13. Any member making, or causing others to make, any disturbance or row in the club-room, will be fined threepence.

14. Any member swearing, or repeating an oath in the club-room,

or under the verandah outside the door, shall be liable to a penalty of twopence each time, to be paid to the club.

15. Any member getting vegetables in the garden-fields after nine o'clock on a Sunday morning, by Rothamsted time, will be fined sixpence.

16. Any member not paying his money before ten o'clock on the quarter night will be fined threepence; if not paid within one month from that date, he will cease to be a member of the club, and will forfeit his garden; he can then only enter the club by a fresh election and the payment of a fine of one shilling.

17. Any member not keeping his allotment-garden clear from seed-weeds, or otherwise injuring his neighbours, may be turned out of his garden by the votes of two-thirds of the committee, after receiving proper notice.

18. Any member wishing to give up his allotment, must give notice to the committee, and the succeeding tenant can enter on any part of the allotment which is uncropped at the time of notice of the leaving tenant.

19. The committee shall meet four times every year for transacting the business of the club, namely, on the first Monday in January, the first Monday in April, the first Monday in July, and the first Monday in October, from seven to eight o'clock in the evening. Any member not attending, except in the event of illness, shall pay threepence to the funds; and no member shall allow his name to be put down to serve on the committee unless he is in a position to attend, and take an interest in the same.

20. As soon as possible after the death of a member of the club, the sum of two pounds shall be paid out of the funds of the club to the widow, or widower, or if the member is not married, to the nearest relation.

21. Any member drawing or giving beer to those who are expelled from the club, shall be fined threepence.

22. No member shall be entitled to the money paid at death until he has paid up all his subscriptions and fines for twelve months.

23. Any member breaking a mug, is to pay the cost of replacing the same.

24. Rents for the gardens are due on the 29th of September; if not paid within one month of that date, the members who have not paid will forfeit their allotments, and will be proceeded against by the committee for the amount due in the County Court. If paid between the 29th of September and the 29th of October, a fine of sixpence will have to be paid.

25. Any member or members belonging to this society found

fighting, or striking in the room or in the field, will be liable to a penalty of five shillings for each offence, to be paid to the club.

26. The books of this society shall be examined every half-year, and a full statement made of the income and expenditure of the society at a general meeting, and a full report shall be presented to the members at the annual meeting of the members in June.

27. Any member taking tools from another man's garden without leave, and not returning them the same day, will be fined one shilling.

28. Any member laying dung on the gravel roads, will be fined one shilling for the first offence, and for the second offence he will be expelled from the club.

29. Any member who sells the produce of his garden to a stranger, must be present himself—or some of his family must be present, or he must give notice to the man who attends to the walks to be present—when the produce is cut or removed. If the purchaser removes the produce without a witness, the owner of the garden will be fined one shilling.

30. When a member has drawn his barrel of beer, he must show himself in the club-room, and ask for the next member to take his place, or be fined one shilling; but if no one is there to take it, he can tap a second barrel.

31. Any member making a dispute about any of the rules, it shall be settled by the committee, and their decision shall be final.

The reader need not be detained by comments on the admirable remarks of Sir John Lawes, or on the Rules of his Allotment Club. Nor need I dilate on the kind of amusements which are in the present day accessible to the young of a contented rural district. With a good club there would certainly be good lectures. There are such now in many parts of the country. Most of our schools teach elementary science and art—the former not always the best, nor practical, yet still good and elevating. It is quite possible to provide science in such form that it may be neither difficult nor superficial, and to instil a love of nature and thereby of true art, so that it may lead to pure sentiments expressed without pedantry. These can thus be conveyed in a manner suitable to the true and simple natures of good and artless people. With such aims, and they exist now all through the land, there need be no lack any more of all the occupation and recreation which may conduce to Village Health among a population advancing by inheritance and education in intelligence and capacity.

5.—CARE IN SICKNESS.

No village of any importance can be considered properly provided for, in respect of the health of the labouring classes, which has not four separate factors for ensuring care of them and their families in sickness. I do not include life insurance, or burial, clothing, or coal clubs. The four are a Cottage Hospital, a Dispensary-house, a Provident Dispensary Society, and a District Nurse. For a poor district where these are most needed, this may seem an excessive requirement, an expectation not to be realised.

It is manifest, however, on reflection, that all these may be combined in one house, and at little cost. Suppose now, a double cottage, in good sanitary condition—if an old farm house adapted, so much the better—suppose the district policeman, living in one half, paying only half the rent of the cottage, and his wife taking care of the other half. The downstairs front-room of the empty half being then the doctor's room, the back-kitchen being the waiting-room, and the upstairs room arranged to take two cases of accidents or acute illness. The doctor (the Union Surgeon) attends, in his room, at stated days and hours, to all parish cases, or provident dispensary cases. He keeps here a stock of his ordinary drugs, the requisite dispensing arrangements being provided for him by the Guardians. His bad cases from the neighbourhood send there for their medicines after he has seen and prescribed for them. His provident dispensary cases do the same. When a bad case requiring regular nursing is brought in, he gets from the nearest county nursing institution a skilled nurse for the time being—an arrangement according to the nature of the district being made for the payment of her services by the proper persons, legal, or charitable, or personal.

All the above, except the nurse, can be provided for ten pounds a year ; indeed, it can be paid out of the Provident

Dispensary Funds. The comfort to the surgeon and the poor is incalculable. Thirty years since, these simple arrangements were proposed by me to the then Poor Law Board—with this addition, that the Board of Guardians should pay the bill for the wholesale druggist, and that in large districts they should always provide a dispenser to relieve the surgeon of the labour as well as the expense of dispensing his Medicines. This last plan is now adopted in various Unions. Into the relative value of Charity Dispensaries and Provident Dispensaries there is no need to enter here. The latter, through the exertions mainly of Sir Charles Trevelyan, have been successful even in London, and are largely spreading in our towns, notably in Northampton. But the method is also extending to the country villages, to the satisfaction alike of the medical staff and of those who value the independence of the poor—whether among themselves or their richer friends.

The reader will observe that each of the arrangements here advocated, viz., hospital, dispensary, provident club, and district nurses, are here spoken of as they may be administered with advantage in the very poorest district and in the simplest form. Space forbids that I should trace the development from this simple type up to the fuller scale attainable or attained in the larger and more populous villages, or in the lesser borough towns, or in the neighbourhood of wealthy residents. District nurses, one or more always resident, exist in some county parishes; quite different from the parish *sage femme.* District nurses always should be, and generally are, skilful persons trained to be nurses in suitable large hospitals. Every county hospital should be able to train and supply them to its county. It is so with some; it might be so with all, and probably will be. Telegraphic wires run through all our chief villages, and the villages would often be better served by establishing a connexion with the nearest central Nursing Institution than by having one person often unemployed for many weeks, and then perhaps overtaxed by the distance she might be expected to travel.

The cottage hospital, as I have described it, in its rudimentary but useful shape, may, if necessary, grow up into the miniature but complete hospital such as exists in towns like Banbury; or, such as in Aylesbury rivals the large institutions of Provincial centres in providing both for curative and preventive medicine.

These two factors—the trained district nurses and the cottage hospitals—are slowly transforming the methods for the cure of the sick poor, and indirectly, too, affecting the well-being of the rich in country villages. The able and cultivated young men now passing in large numbers through the offices of trust, surgical and medical, of our Metropolitan and greater provincial schools, are able and willing to undertake with knowledge and with the confidence that knowledge gives, the management of almost all cases of disease and injury. For these, however, they need two things, when they are placed in rural districts, viz., a hospital and a skilled nurse, who may all be trained to dispense for the union surgeon, in the village dispensary. The public mind is seizing these conceptions. Both will be gradually provided, and capable practitioners will be found in all the principal villages which need them. Nothing seems to be more certain than this. There is only one fear, that the development of public interest in these directions will attract more workers than can live by their labour. On the other hand, as regards the Nurses, women of the highest character and education are leaving, for a time at least, some of the frivolities of town life for a more engrossing and healthy occupation, viz., the intelligent and skilful care of the sick poor. For such trained service, blessing and blessed, hospitals, workhouse dispensaries, cottage hospitals, and districts are offering ample opportunity in the remotest Village as well as among the denser dwellings of the Metropolis.

III.

THE LESSON LEARNT.

ILLUSTRATIONS FROM VARIOUS PARTS OF ENGLAND.

The tale of the village has been shortly told. The needs have been briefly stated. The lesson has to be learnt.

It has been shown how vile and terrible are some of the physical conditions of the poor. I do not care to discuss the relative misery of the bad portion of London, which I have known nearly as long as the huts of St. Kilda. The evils are different. The causes are in many respects dissimilar. It is not, however, certain that the remedies of both are not in some measure correlative. The people have crowded into the towns. Seeking to lighten their own burdens they have added to those of others, and have not diminished their own. In the towns gigantic efforts have been made and are being made to remedy the existing evils of the dwellings, and to check the rising tide of difficulty. The Shaftesbury Estate; the Peabody dwellings; the railway companies in various ways; Miss Octavia Hill's work, with a thousand other plans, have striven and are striving to stem the torrent in London. Two or three salient instances selected in the north and middle of England, and the records of great public bodies, will show something of that which has been attempted, and the principle on which it has been attempted for our village populations.

But it is certain that a foreigner crossing England from the Land's End to the Nore, or from Freshwater Gate to John O'Groat's House, would be as struck, as he went, by the contrasts in the rural dwellings of the tillers of the soil, as by the variety in the geological formation of the lands and of occupation of the people. He would read the "tale that has been told." He would also see the ornate and carefully-arranged habitations that are near the parks, and the mansions which are among the features of this island of gardens. By a few salient instances I propose to show what is in progress in this direction of improvement and care, and the general principles on which it has proceeded.

Sandringham.

These principles, as regards labourers' dwellings, can be well shown in the east of England at Sandringham, and by the gracious permission of His Royal Highness the Prince of Wales I am enabled shortly to illustrate them by what I have observed there. This particular property is not extensive, and therefore the facts can most readily be seen.

1st. There are cottages in good order, ample for the wants of the parishes to which they belong.

2nd. These are of very various descriptions :

a. Old ones found on the property have been judiciously repaired when fit for repair, others have been removed.

b. They are of various descriptions, suited to the wants of rural labourers.

c. The village shop, which may be reckoned as a double cottage.

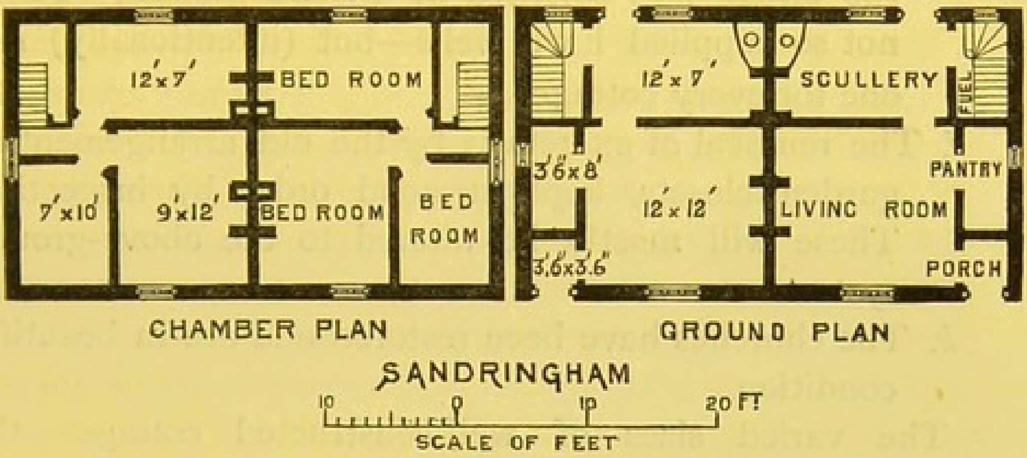
d. The dwellings for the labourers with a family are of two dimensions, the larger, or Alexandra cottages, the smaller or Louisa cottages. These each, however, contain sitting-room, scullery, pantry, store, three bedrooms, two having fireplaces, the staircases being conveniently arranged. A garden of about 20 poles.

(Opposite are the ground plan and chamber plan of a pair. The same plan practically as the " Standard," No. 15.

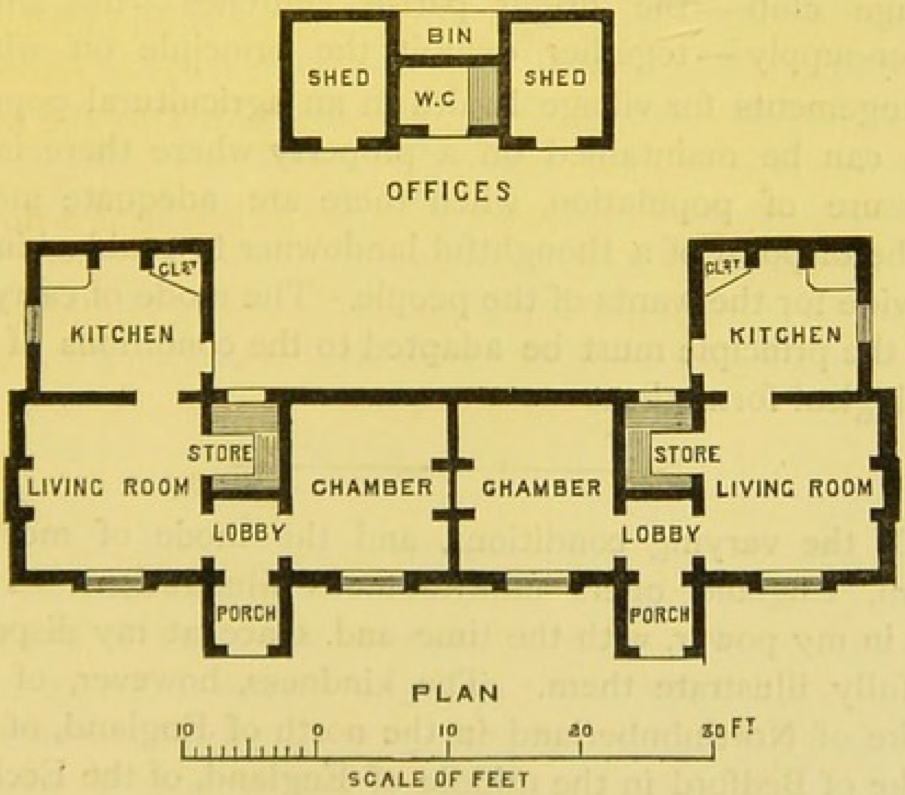
The internal arrangements could not be more convenient ; though, as has been said, changes may be rung in applying the general principles.)

e. Smaller cottages on one floor for aged couples, or for couples without a family, with three rooms, each room having a fireplace.

f. A cottage hospital, wherein a married couple live pursuing their respective avocations. Two airy furnished rooms, with possible supplementary apartments, are therefore always ready. A woman nurse can be obtained at any moment by telegram from a neighbouring institution.


12'x7'
BED ROOM
7'x10'
9'x12'
BED ROOM
BED ROOM
3'6"x8'
3'6"x3'6"
12'x7'
SCULLERY
FUEL
PANTRY
12'x12'
LIVING ROOM
PORCH
CHAMBER PLAN
GROUND PLAN
SANDRINGHAM
10
0
10
20 FT
SCALE OF FEET

45. PLAN OF A COTTAGE AT SANDRINGHAM.


BIN
SHED
W.C
SHED
OFFICES
CLST
KITCHEN
CLST
KITCHEN
STORE
LIVING ROOM
CHAMBER
CHAMBER
STORE
LIVING ROOM
LOBBY
LOBBY
PORCH
PORCH
PLAN
10
0
10
20
30 FT
SCALE OF FEET

46. PLAN OF A COTTAGE AT SANDRINGHAM.

g. There is no public-house in four adjoining parishes. Many of the villagers are wont to keep small casks of beer brought round from a neighbouring brewer.

h. A village club-house, or reading-room, is in course of erection in the present summer.

i. To a part of one village, as well as to Sandringham House, there is constant water-supply from a water-tower, the water being raised by steam-power from the chalk, and softened by Clark's process. Those not so supplied have wells—but (intentionally) not one for every cottage.

i. The removal of excreta is by the old arrangement of garden closets, kept in good order by inspection. These will mostly be altered to the above-ground system.

k. The churches have been restored and are in beautiful condition.

The varied sizes of well-constructed cottages—the absence of public-houses — the cottage hospital — the village club — the bright parish churches — the ample water-supply — together exhibit the principle on which arrangements for village health in an agricultural population can be maintained on a property where there is no pressure of population, when there are adequate means at the disposal of a thoughtful landowner to enable him to provide for the wants of the people. The mode of carrying out the principle must be adapted to the conditions of the geological formation.

Of the varying conditions, and the mode of meeting them, England offers multitudinous illustrations. It is not in my power, with the time and space at my disposal, to fully illustrate them. The kindness, however, of the Duke of Northumberland in the north of England, of the Duke of Bedford in the middle of England, of the Ecclesiastical Commissioners of England, and of the Honourable Charles Gore, Commissioner of Woods and Forests, enable me to name types of these conditions ; while His Excellency the Earl of Spencer, by permitting the description just given of Church Brampton, shows a case of complete rural water-supply and water carriage of excreta; and the Earl of Rosebery and Mr. Cyril Flower have furnished me with examples of complete and successful superintendence of the other chief mode for the disposal of refuse.

Bedfordshire.

From the hundreds of examples which might be given of the views of great landowners on village arrangements, two only can be selected, one from the south and one from the north of England. Any one who desires to see a typical example of careful consideration bestowed over a long series of years might advantageously repair to Woburn. There is a valley to the east of the Abbey at Eversholt, where, beyond the circuit of the property of the Duke of Bedford, may be seen cottages of the type of Lowmarsh, with both the virtues and the faults of the tenements described there. There are the orthodox two rooms above and below, the upper with only some 600 cubic feet of space, the bedroom of a cheery couple, the man, of eighty-three, has lived there in health and happiness these sixty years, and would be heartbroken to leave this picturesque abode, full of the associations that belong to a large family brought up in contentment, in their little crowded home, or lives of labour.

Not far off may be seen a recent example of the Duke's anxious care to discover the rules for constructing an abode most fit for the peasant labourer. The old cottage just described is rented for a shilling a week; the latter, the result of every careful thought, for sevenpence more. It is a type of a simple unadorned structure, massive, and considered carefully in every point. It has overhanging eaves for dryness of foundations, hard-brick causeway surrounding it; a yard of asphalte laid on concrete, a little barn, and wash-house and earth-closet; the rain-water tank and protected well, with covered pump. The wooden floors and staircase, and ample rooms, two below and three above, contain everything which a moderate family would desire, in any station of life, for real need. But then the cost? Not less than £370, without reckoning the ground and the spacious garden, or any expense of professional superintendence. I take these two cases as typically showing the two extremes of village life. The first case is that of a life not unhappily led through a long family history. The second is a complete illustration of careful arrangement without waste or ornament, but with a skilled consideration for the wants of the people. It is needless, almost, to add the words that as a commercial undertaking the Duke's cottage is out of the question with the present amount of peasants' earnings, or any that are probable in the future.

In and near Woburn may be seen similar effort bestowed in various manners and degrees. It would require a special treatise to record the several plans in detail in which, during forty years, these modes of village life have been studied and put in force in respect of education and of dwellings. It would be instructive to some outside critical observers did they know the extent of unceasing supervision of the most exact kind that has been and is employed to obtain the result that is everywhere to be seen. Had I, indeed, space to do this now, it would be to violate the trust which put every particular into my hands on the occasion of a recent examination made with Mr. Wing, His Grace's administrator. The cottages are all carefully repaired every six years, and on every change of tenants they are cleansed and whitewashed; they are quarterly inspected, the tanks and spoutings periodically cleansed and repaired, and every cottage fumigated and cleansed by the landlord after all infectious diseases. Indeed, the amount of thought that is bestowed on the thousands of cottages of this great proprietor in divers parts of England, is itself a lesson of lifelong exertion in the cause of the village labourer.

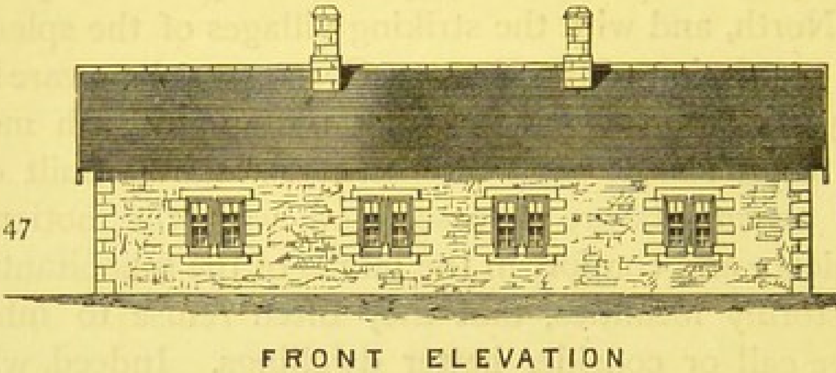
Northumberland.

I select one other example of village life on a great scale for a special object and to enforce a special lesson, not theoretical, but practical. In the outset of the essay, certain standards of cottages were given with the conviction that no one standard or model is desirable or attainable. Any one acquainted with the populous villages of the pitmen in the North, and with the striking villages of the splendid fishing population of the Eastern Coast, must be aware how far they are removed, even in design, from any such model as has been shown here. Some of the solidly-built one-storied tenements are so associated with the notion of convenience and comfort in the minds of the inhabitants on those stormy localities, that they often refuse to inhabit what we call or consider better dwellings. Indeed, where land is of little value they are doubtless right. Visitors sometimes confuse the filthy surroundings with the type of the house itself. This is an incorrect impression. The *interior* of the northern pitmen's homes, and the dwellings of the fishers, are, in many cases, as remarkable for their neatness, their order, and their convenience, as their inhabitants are for courage and sagacity.

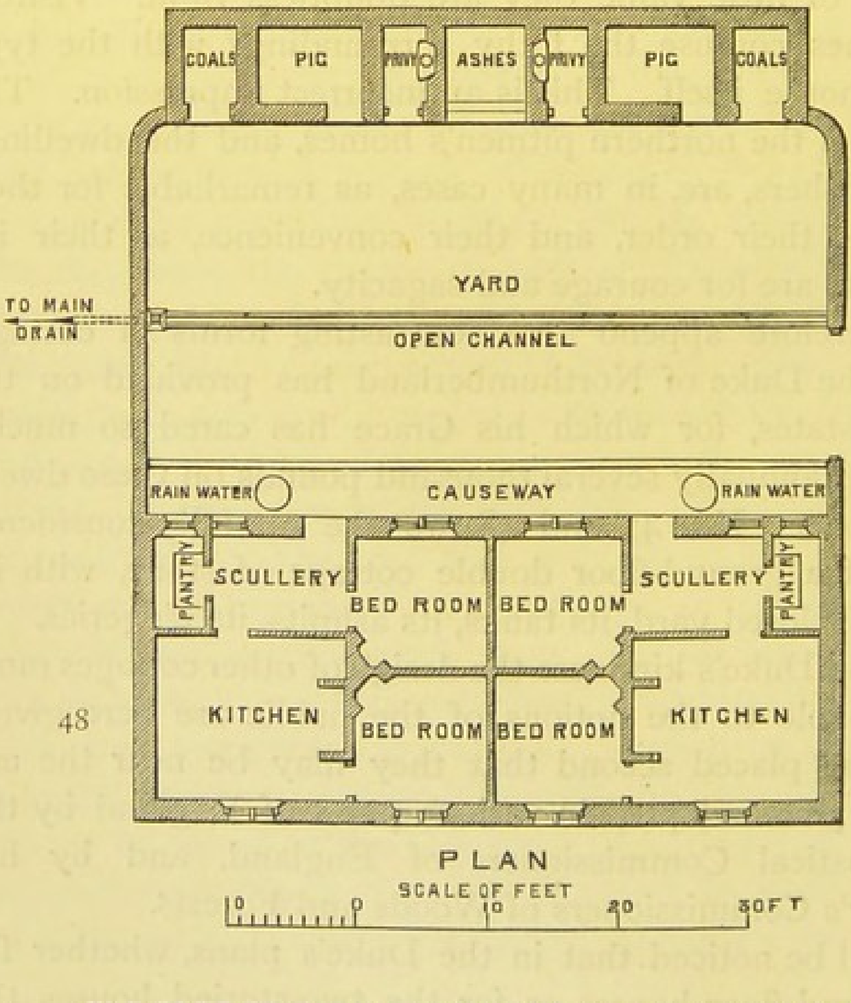
I therefore append two contrasting forms of cottage, which the Duke of Northumberland has provided on the great estates, for which his Grace has cared so much; spending annually several thousand pounds on these dwellings alone. No. 47 and 48 are the carefully-considered plans of a ground-floor double cottage of stone, with its snugly inclosed yard, its tanks, its ashpits, its piggeries.

By the Duke's kindness the design of other cottages more conformable to the notions of the public are here given. They are placed second that they may be near the admirable plans adopted in various parts of England by the Ecclesiastical Commissioners of England, and by her Majesty's Commissioners of Woods and Forests.

It will be noticed that in the Duke's plans, whether for the ground-floor houses or for the two-storied houses, the principle on which the outbuildings are here laid out is to inclose them in a common yard. They who have wandered on our eastern coasts, or on the cliffs and moors of Cornwall, must know well the comfort of the wall built in solid stone, a shelter against the cruel gale, and protection to the single house door at the back—an arrangement not desirable in situations less exposed.


FRONT ELEVATION

47

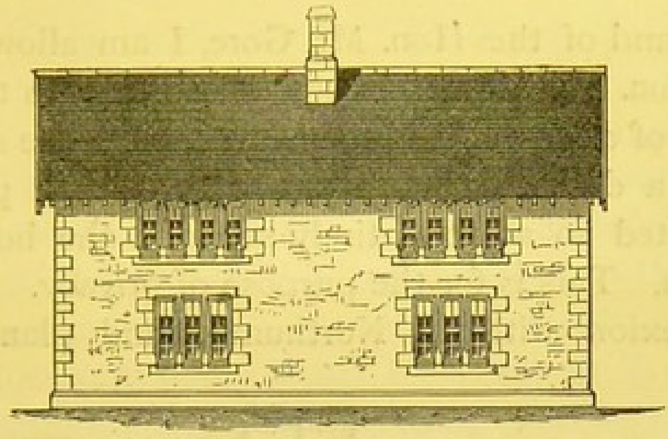

COALS
PIG
PRIVY
ASHES
PRIVY
PIG
COALS
YARD
TO MAIN DRAIN
OPEN CHANNEL
RAIN WATER
CAUSEWAY
RAIN WATER
PANTRY
SCULLERY
BED ROOM
BED ROOM
SCULLERY
PANTRY
KITCHEN
BED ROOM
BED ROOM
KITCHEN
PLAN
SCALE OF FEET
10
0
10
20
30FT

48

THE DUKE OF NORTHUMBERLAND'S ONE-FLOOR COTTAGES.

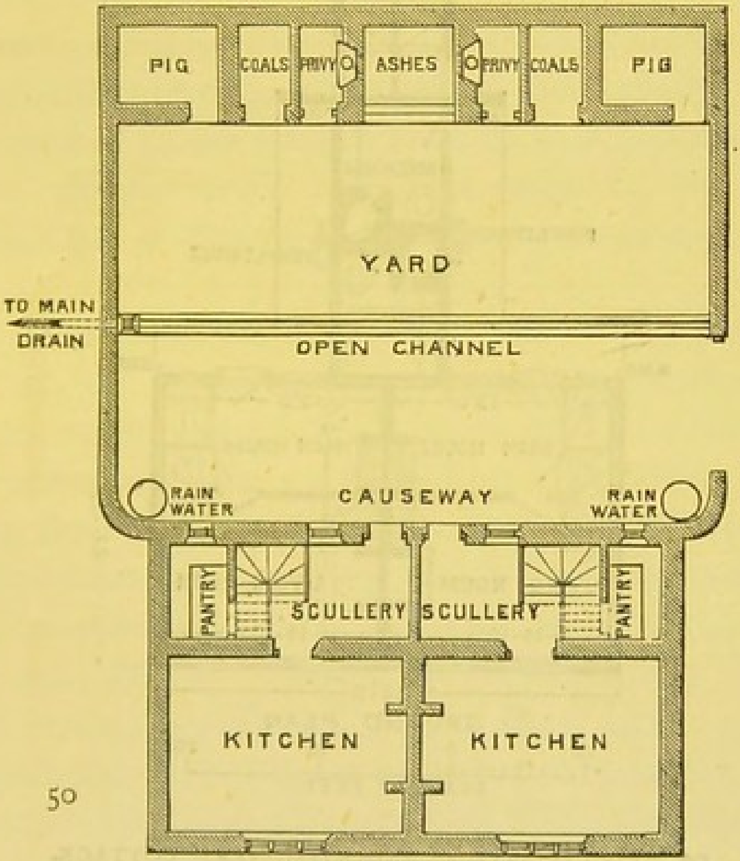
In contrast with this disposition of the court may be put at once the ground-plan lately adopted by the Commissioners of Woods and Forests and the Ecclesiastical Commissioners, which, by the kindness of Sir George

49



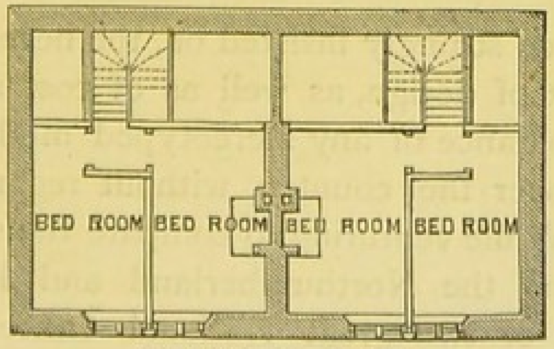
FRONT ELEVATION

50


PIG
COALS
PRIVY
ASHES
PRIVY
COALS
PIG
YARD
TO MAIN DRAIN
OPEN CHANNEL
RAIN WATER
CAUSEWAY
RAIN WATER
PANTRY
SCULLERY
SCULLERY
PANTRY
KITCHEN
KITCHEN

GROUND PLAN

51

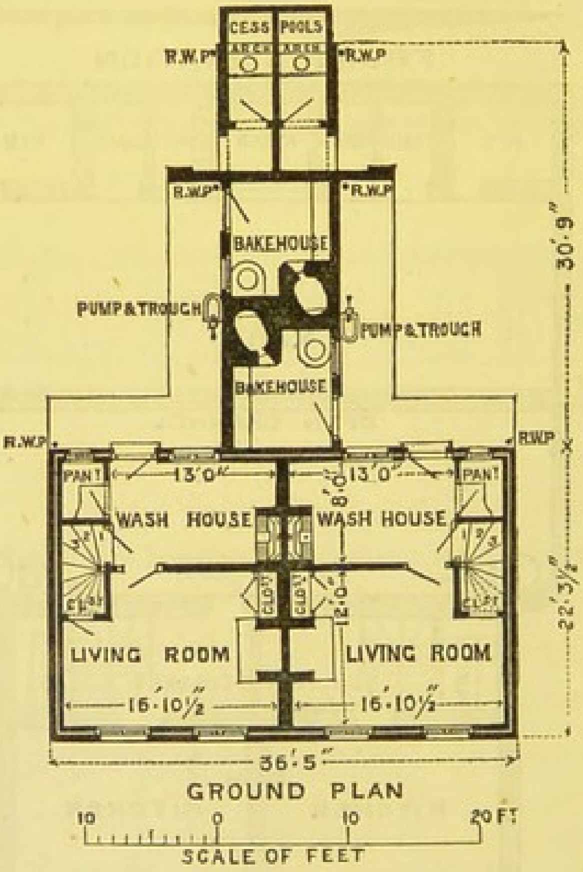

BED ROOM
BED ROOM
BED ROOM
BED ROOM

CHAMBER PLAN

SCALE OF FEET
10
0
10
20FT

THE DUKE OF NORTHUMBERLAND'S TWO-STOREY COTTAGE

Pringle and of the Hon. Mr. Gore, I am allowed to use as illustration. It will be noticed at once that in this southern cottage, of excellent arrangement (though the single house-door is a doubtful improvement), the back premises are constructed so as to entirely separate the houses in that direction. This is for the purpose of privacy. It illustrates in connexion with the Northumberland plan that which cannot be too strongly insisted on, the necessity of freedom and variety of design, as well as of cost and dimensions, and the avoidance of any stereotyped method to be sown broadcast over the country, without regard to local experience. While venturing to compare the systems pursued in regulating the Northumberland and Bedford villages with those of two great National Offices, those of the Ecclesiastical Commissioners and the Commissioners of Woods and Forests, it is interesting to note how the private owner can use, if he be willing and able, a freer hand than


CESS POOLS
R.W.P
BAKEHOUSE
PUMP & TROUGH
WASH HOUSE
LIVING ROOM
PANT
CL.
13'0"
8'0"
12'0"
16'10½"
36'5"
30'9"
22'3½"
GROUND PLAN
10 0 10 20 FT
SCALE OF FEET

52.—ECCLESIASTICAL COMMISSIONERS' COTTAGE.

the trustees of the public purse. But the condition of the property of these great State offices, as bearing on this whole question of Village Health, is so instructive, and the good done throughout England so great, that I add a condensed statement with which I have been favoured.

The bulk of the estates now in possession of the Ecclesiastical Commissioners was, until within recent years, held on beneficial or renewable leases for years or lives, or on copyhold grants for lives, for the most part in numerous small holdings.

On the lapsing or purchase of the outstanding leasehold or copyhold interests, these properties usually came into the possession of the Commissioners in a dilapidated state, and the cottages which had been originally constructed of unsubstantial materials, were in many cases unfit for habitation.

The Commissioners have from the first recognised the obligation of providing suitable accommodation for the labourers employed on their farms, and, in addition to the improvement of such existing houses as were worth improving, they have erected some hundreds of new cottages on their estates, and on those which have been transferred to Ecclesiastical Corporations for permanent endowments.

The cottages so erected are substantially built with hollow walls, usually in pairs; they have each three separate bedrooms, and are provided with a proper water-supply and detached offices, so that their sanitary condition should be ensured.

As typical cases of estates in which improvements of this nature have been made in the habitations of the labouring poor, the two following may be selected, viz., Staverton and Thorverton in the county of Devon.

The estate now in possession of the Commissioners in the parish of Staverton is about 3700 acres, which have been acquired since 1862 by the purchase or lapsing of beneficial leasehold or copyhold interests, in nearly 100 holdings.

The houses and cottages standing on these small intermixed holdings at the time of their acquisition by the Commissioners were generally of an inferior character, being timber-framed, cob and thatch buildings, and, in many instances, they had become greatly dilapidated from neglect.

The estate has now been thrown into farms of reasonable size and compactness, and comprises fourteen farms of 100 acres and upwards, and about thirty smaller occupations.

The cottage accommodation provided for these holdings consists of thirty-six new cottages, built by the Commissioners, and thirty-five cottages (partly old farmhouses converted), which have been altered and improved, so that they are now comfortable dwellings.

The estate in Thorverton, now in possession of the Commissioners in this parish, comprises about 1300 acres, and has been acquired since 1862 by the purchase and lapsing of leases and copyhold grants, as in the case of Staverton.

In this case the Commissioners have built eighteen new cottages, and altered and improved ten old ones.

Nearly the whole of the village of Thorverton was held on beneficial leases, and had got into a bad sanitary condition. Those of the houses which were unfit for habitation have from time to time been removed as the leases fell in, and those of a better class which were not needed for the farms were sold to the respective lessees, so that they might have an interest in aiding in the general improvement of the village.

The water-supply has been obtained from a spring on the estate at a distance from the village. The water is conducted by pipes into a reservoir near to the church, and the reservoir and works have been recently made over by the Commissioners to the Parish Authorities for the general use of the population.

It may be stated that the cost of building the new cottages on the estates above mentioned has been from £375 to £450 per pair, including outbuildings, nearly the same as those given above (p. 35.) The difference in the cost arises not from alteration in design, but from the gradual increase in the cost of building during the last twenty years.

Nor less instructive is the following example :—

The Commissioners of Woods consider it essential that the cottages, situated on the Crown estates, and intended for the occupation of labourers on those estates, should be sufficient in number and suitable in size and construction.

Since 1851 the Commissioners have built 522 new cottages for labourers, and have enlarged, or otherwise improved, 311 existing cottages.

The new cottages are usually built with hollow walls, and almost invariably contain five rooms, with pantry, detached fuel-house and other conveniences, and also with garden and water-supply. Ovens are added where they are necessary. They are usually built in pairs, and, in recent years, the cost of a pair, under ordinary circumstances, has been upwards of £450.

In the enlargement of existing cottages, an endeavour is made to provide, in each case, as much accommodation as is provided in the new cottages.

But I must now draw these remarks to a close with one observation. If any one should be at the pains to read the depressing account of the villages of England published by Dr. Hunter, in the year 1864, in Mr. Simon's invaluable series of Reports to the Privy Council, and then reflect on the mass of effort that has been brought to bear on improving the healthy condition of our village dwellings as well by great owners as by public authorities, he will conclude, as I conclude from observation and from reason, that the present is wholly unlike the past; that we know at what to aim, and that the result is as sure as the aim is true. How to deal with small freeholds, the property of the needy, is a question in which I do not now enter. It is one to be approached with caution. Compulsory closing and destruction may lead to further evils in the country, and to more disastrous crowding into the town. The Royal Commission on the dwellings of the labouring classes will give all the advice which devotedness and ability can bring to bear on this national problem: only let us seek to save if we can, the haven of simple English life, and peaceful peasant homes.

Earth Closets at Tring.

One point of detail in village administration remains. In a previous section the arrangements for removing excreta by water-carriage adopted by Earl Spencer were described as being typical of this thorough mode of refuse removal. An instance of the other method carried out by individuals with equal perfection on the Rothschild estates should be described, as it is the method best adapted to single or detached cottages, and straggling villages. The closets used are Moule's Patent. They are arranged as follows, every detail being carefully and well constructed:—An ample hut is constructed; on one side of it is a cupboard of about 7 feet high, and area of about 9 feet. This is a receptacle for storing clean dry earth, and will hold about a month's consumption.

Next to it, at the rear, is the door to the back of the closet; above, is the receptacle of dry earth, below, a tank about 2 feet deep for the dejecta.

For a small family about 1 cwt. of earth is required weekly; i.e., about 3 tons annually.

The tank is emptied weekly, i.e., for one cottage, one barrow load; for twenty cottages, one ton—a cart load. To do this, two men, a horse and cart with their care-taker, are practically required; but the same staff will keep 150 cottages, within a reasonable distance, taking 8 tons of dry earth to the cottages, and removing the same, plus the weight and mass of the excreta from the cottages, to the place of deposit; the distance to be traversed from the place where the earth is kept to the drying-house, then to each of the 150 cottages, back to the drying-house, and then ultimately to the land—all these manifestly imply factors varying in every locality. I speak, therefore, but roughly. Besides the man in charge of the drying stove, and the man for the horse and cart, one or more are needed to collect and prepare the untainted earth, whencesoever obtained, for the 150 cottages; that is to say, about 300 tons annually, or about 1 ton a day. I first said 3 tons a year for each cottage, and here I have said 2 tons. The former amount was the quantity of the earth used by the cottages, I now speak of the *fresh* earth, freshly dug up. The meaning of this will appear directly. At Tring, on the estate of Sir Nathaniel Rothschild, is the central drying kiln, working for about 150 cottages, in five villages, including part of Aylesbury, seven miles off. But at Aylesbury the product is not returned. Only the 52 tons of *dry* earth travel thither annually, or a load weekly. I will not pursue these details, for as I said in every district they must vary. The cost, therefore, also must vary. The principle remains exactly the same. This central kiln supplies the Rothschild cottages at Tring, Aston-Clinton, Weston Turville, Aylesbury, and Buckland. The earth is the detritus of chalk, dug and screened small. This is baked on hot iron plates over a furnace, with an exposed surface of about 80 superficial feet. When heated and dried it is stored under a shed for use, and this is carried on actively in the summer so as to store up under cover for the winter's consumption the requisite tonnage of dry earth. The known quantity for 36 cottages in Tring is taken round weekly, with this reservation, that some cottagers may prefer to fill their closet from their own store, described as before. Therefore their store is supplied with four times the weekly load once a month. This again is only a matter of detail. The earth is taken in sacks, each holding about 200 lbs. This is emptied partly into the hopper, partly into the store closet, as implied above. Then once a week the removal tank is emptied by a handy scoop in a few minutes.

Now the tainted earth so removed is almost inodorous. It is taken back to the central store (weekly)—say from 20 cottages, each day; about 6 tons weekly is thus dried in the kiln, and put in store for a second use. This is taken round in due course, and returned; and this residue, after its second use, is carted to the woods or the fields for manure. These are, therefore, in store always: 1st, pure dry earth; 2nd, the first returns; 3rd, the second returns.

The shed is absolutely inodorous. The same was the case in every cottage that I visited.

The school was in striking contrast with the cottages. It is managed with ordinary so-called dry earth, and the arrangements are offensive and foul—a remark made not for criticism, but for instruction. Mr. Richardson, the intelligent manager of the cottage arrangements, was convinced that no ordinary dry earth (i.e., without kiln,) or ashes, could ever produce the effect always obtained by the method described. It only remains to be said that nothing can be more satisfactory than the result, save only the cost.

A confirmation of the above remarks is given me by the kindness of the Earl of Rosebery in the following statement by Mr. Knight Bruce. I have been unable to examine Mentmore personally, and I am the more indebted for this Paper:—

"At the present time we have about 150 earth closets built in connection with the cottages on the Mentmore estate, and we find the system working admirably. Each cottage, as a rule, is provided with a barn, and under the same roof an earth closet is fixed. The form of apparatus generally used is that known as the 'self-acting' apparatus. A charge of dry earth, about 1½ pints, is delivered automatically on the user of the closet rising from the seat, and effectually conceals the contents of the receptacle; this receptacle should be a water-tight vault of the same width as the closet, of about 4 feet from front to back, and from 2 to 4 feet in depth. The vault should be formed of brickwork and lined with cement. Into this vault the excreta and earth will fall, and when required to be emptied the material is removed through a small door at the back of the closet. After the vault is emptied, dry earth should be spread over the bottom. We find dry-sifted chalk a very good substitute for earth; at the same time it is a powerful absorbent. If the chalk is not sufficiently dry, we place it on the 'drying stone' before using. The product of the closet, namely, chalk and excreta, is placed in a covered shed open at one end, and when required for use is dried on the drying-stone, when it becomes perfectly inodorous, and this material is used over again in the closet. I would prefer, instead of drying the product on the drying stone, to place it under an open shed, sheltered from rain, and exposing it to wind for about two months, and occasionally turning it over until it becomes sufficiently dry to use over again in the closet. Under this system its value as a manure would be increased.

"It has been estimated that earth used but once in a closet is worth, when dry, from £2 to £3 per ton. The value of the earth manure increases in proportion to the number of times it is passed through the closet.

"On this estate two, even with a horse and cart, are constantly employed emptying the earth-closet vaults. The cart is divided in the centre with a board, one side being used for dry chalk, the other for the contents removed from the closets. Each cottage has its earth-closet emptied twice a week regularly."

It is fair here to say that a well-known sanitary engineer writes to me that, "The difficulty which has always arisen has been caused by the trouble of keeping the closets regularly clean. It has been found by experience that the tenants themselves will not do this, and that the only way is for the sanitary authority in the village to do it themselves. This is all very well where the property belongs to one person, but to get over the difficulties is so serious a matter that in many cases it has proved a failure. In adopting the dry-earth system it must also be remembered that drains have to be laid to take the slop water, and consequently the cost of the earth system, if the village is properly drained, is not so cheap as it would appear at first sight."

From all my enquiries during many years I am satisfied that the Rothschild rural administration is the true and only one, viz. regular and compulsory supervision. This may be by voluntary arrangement in the case of great landlords, or by the sanitary authority, as in towns. But official charge of the scavenging there must be, if cleanliness is to be secured.

PROGRESS.

This brief review of facts in respect of Village Health is like some dramatic scene of horror and of beauty, wherein evil and good contend for victory. In the first pages were two sketches, one of St. Kilda, and one of huts under shadow of the great aqueduct of Carthage. I was impressed in my youth by these contrasts between the loathsomeness and degradation of filth, and the grandeur of efforts made by a great nation for a supply of one of the simple necessaries of man. I can never forget, I now often see, the vision of the massive walls that guarded the bright outpouring of the splendid stream above the oasis of Zagouan, which was conveyed to the city of Dido by an aqueduct, just as in the better-known Campagna of Rome. But so warned and so taught, with what strange amazement did the same youth stand by the wooden undershot wheel as it pumped water impregnated with sewage from the slums of St. Thomas's round the City and the University of Oxford until the year 1856. Not till the cholera year of 1854 was it known that in that famous city the gruel of the county prisoners was made from the same source. Almost till then a merry college-porter was Chairman of the Guardians of the City parishes. The foul cell for the unhappy prostitutes in the Workhouse now pulled down was more loathsome than country kennels which I knew. Most workhouses and workhouse hospitals are now, I believe, fairly good, and there is perhaps no place where the chance of health is greater than in a County Prison. The head of the Cathedral College of Oxford, himself as laborious in scholarship, as broad in his social, political, and scientific interests, was for years the active Chairman of the Committee which has given to this same city an efficient and masterly system of drainage, laid down on the most scientific principles. Fever dens in the hospital a disgrace to any institution, have been replaced by wards as bright and as good as any fever-stricken wretch, whether poor or rich, could desire for care and for recovery; while in the laboratories of the University, Burdon Sanderson and his colleagues are investigating the biological conditions under which zymotic diseases flourish or decay, with every appliance in preparation for the complete investigation of these astonishing phenomena.

This is but an example. What has happened in one central city has happened often more quickly, and on a larger scale, throughout the land. It could not be in England as it has been, and is, in the United States, that on virgin prairies there should be laid out with complete knowledge, scientific skill, and patriotic insight, the Model Village. We, with the proud inheritance of the making of England, have also the legacy of many a Lowmarsh. We have to deal with each of these amidst the growing difficulties of increasing population, with the fresh demands and new discontent which education and material surroundings, dazzling every sense, have brought in our day. We cannot, if we would, with Waring, lay out large territories of some square miles, beginning with the church and the school, planted at the central intersecting streets; placing the cottages and the farm, precisely where on a settled plan they are most handy; and arranging all their details of water-supply and drainage, just as we lay out the new parts of a modern suburban district. There are no places left where this can be done for the first time in rural England. The attempt was made by O'Connor at Minster Lovell, and it egregiously failed. What can be done has been long begun; and has produced great fruits by individual and by combined exertion, viz., the education in this matter of the people, under the guidance of scientific and humane men, devoted to the prevention of sickness and of bodily suffering.

We have just seen examples of what the individual exertion of great landowners is doing and has done, we have glanced at the tentative efforts on a vast scale of such persons. The lessons are in every corner of our rural districts. Public bodies, acting as trustees of the public funds, have long established all over the country examples of what should be aimed at, if even not to be obtained, of the greatest reasonable comfort with the least waste of capital expenditure. As we have gone on, difficulties, not imagined, have arisen and been met: difficulties of political economy, based on limited data; class difficulties, caused by infirmities on either side, by ignorance, and by prejudice. And yet what have we not seen in the last ten years! I pass by, as not belonging to this Paper, the vast exertions in our large cities, the local improvements, the weighty Acts, such as those of Torrens and Cross—I speak only of the position of our village population. On the advice of the Royal Sanitary Commission of 1871, a local authority was appointed for Sanitary affairs in every spot in the country. These were to be under the general guidance of a Central Government Board, which was to have an adequate staff of the most skilled Engineers, Medical advisers, and Administrators. There is no Hamlet, nay, no Cottage, on the remotest hill-side that is not in immediate relation to the central office, which, more probably than any Council in the world, has access to all that is known or can be known, that bears on the public health. And if we were called upon to show proof of the steps that have been gained, two only need be named. The first is the Report of Dr. Thorne and Mr. Power on hospital accommodation for infectious diseases issued two years ago by Dr. Buchanan, the admirable and overworked successor of Mr. John Simon as chief medical adviser to the Board; and the other, the model Bye-laws for Rural and Urban Authorities issued by that faithful and accomplished public servant, Sir John Lambert. This volume of Bye-laws, illustrated by Mr. Rogers Field, whose name is a guarantee for science and practice alike in this work, gives to every village authority that wills it, the exact details of all that is necessary for accurate sanitary appliances. What contrasts between the present and the past these two documents show! On the one hand, the prevention and the treatment of the chief diseases that call for public surveillance, on the other the state of uncertainty and ignorance of twenty-five years ago. It is perhaps necessary to have lived in both periods to understand the force of this. How much has yet to be done in the arrangement of areas; in the mode of appointing health officers, and in their qualification; in collecting and distributing experience; in hindering wasteful experiments; in avoiding needless expense and needless interference,—need hardly here be said. Two things are certain—the one that the people are becoming rapidly educated in the idea that material order, work, and cleanliness, are among the needful portion of a good, and happy, and useful life; the other, that nothing in this direction should be compulsory by law, unless under the guidance of men of the widest experience and most exact knowledge of what is essential. Such men are being trained in ample numbers to supply the public service. The medical officers of health are the main-spring of the whole machinery. They must be men of strong common-sense, as well as of scientific education. The superior ones, not a large number, must not be in the practice of their profession, and should be responsible only to the higher Boards. All the local sanitary inspectors must make returns to them. Their reports on the multifarious affairs comprised in the term Public Health, should be annually published and presented to parliament, and displayed in every public library through the country. This step alone would disseminate and interchange the varied knowledge acquired throughout the country, and would so educate the whole community that the next generation would look with astonishment at the labours that have been requisite to lay down the principles, and to secure in future to our Garden Island the blessings, of A HEALTHY VILLAGE.

THE END, OR LOWMARSH REVISITED.

I am again on the parish road to Lowmarsh. A quarter of a century has passed by. What have we not seen in this period, whether of human progress, or only of change, or of both? Twice I have been in the United States, before and after the Rebellion, conversing intimately on past, present, and future, with strong backwood men in the clearings and with statesmen in the White House and the Capitol; seeing real life in the detail which builds it up, and hearing the vague generalities about it which mystify. Half-a-million of violent deaths caused by the American rebellion alone; the lightning flash of the Franco-German war; a legion of successes and disasters, bloody and bloodless, all about the world, are some fruits of our civilisation. But what changes, in another way, by the prevention of death and of disease through the awakened care of the Public Health! Since first I was here two Health Officers have been appointed to every district in the country. There is not a hamlet which is not looked after with more or less of discretion and of skill. Is this all sound and right? What has happened here? There, in the distance, are the college and the church. How shall I find them? I am to say something on the health of villages for the Exhibition which the Prince of Wales has set on foot. Yes, thirty years ago, the far-seeing Prince Consort studied with care, among a thousand other things, the dwellings of the poor, whether in villages or in towns. His son now does the same. Another son, Prince Leopold, was in all things nobly following his father's steps in this life—when he passed suddenly to the next. What a multitude of sorrows—and aspirations—what a tale of life! what deaths! But here again is the prim old chapel. It, at all events, is the same. "Here I am," it seems to say, "the World and the 'Bulldog' on one side of me—the School and the Church on the other. I stand at the entrance of things, great advocate for freedom and fight." "Maybe the hand-post is wrong: they often is," drily said a sceptical wayfarer once to me on the Chiltern Hills, as passing he saw me on a stormy winter's night struggling to decipher an old sign-post by aid of a coach-lamp. There is no one near me now. I choose the old road, and go once more towards the church. The post-office is there, and the wheelwright, and the dark pond. The cross has been mended. Opposite is a long row of pleasant and well-built cottages, with gardens and flowers. There is a terrace to the gardens keeping the children safe from the road, as they play about the wall of a well like Rachel's well in a drawing of Fra Angelico.

I come to the churchyard. It is larger and fuller. A rusty old iron frame stands erect at the gate to carry such light as old frames with new lamps can, to those who enter. I cannot cross to the college, for a strong wall is now there. I go round. The college is altered. The maidens' castle is gone. Several of the old hovels are renewed but not removed. Though not rivalling the new in appearance, they please the old folk better than the destruction of their young-life memories could have done. Ah! but the cottage with slush, and the muck-heaps, are there. The small freeholder cannot, however, now live in it, for the roof has fallen in. He, though a poor man, will not sell the soil. It is his birthright. "How is it with Stump Well," I said to a group of women with their children? "Oh! walled all round," they said. "The water runs in pipes under the ground all the way to Summers Town. There's taps in oak 'posties.' 'Waste not, Want not' is cut in them all along by the road," she said. "And I can't pitch mother's bucket into the well no more," said a little urchin, throwing a summersault like a Catherine wheel. "What a sell," he said, as he came up the other side. I returned on my way: there was a green path across a field. All around were allotments let by the parson; in them were well grown wheat, and green crops, and roots. Far beyond, too, many new cottages.

The sun was setting on them. One was a long low roof, where they told me was a dispensary, with a room for the doctor and his patients. The policeman lived there too in peace with his family. They help the doctor and the sick.

When I visited Lowmarsh first, no policeman would be safe. There was then a sullen savagery among the people. A post-boy hesitated to drive me through the village by night. Men connected with the Inclosures Act were more than once in fear of their lives, without any special cause. How different is it now! The cottages near the dispensary were set at different angles and aspects, apparently to show there were two ways of looking at things. There were clean well-built pigsties, and good gardens with flowers. It all seemed, however, incomplete. Order was evolving without force. I passed a recreation ground of five acres. There were boys still playing at cricket. I walked on: I came to the old pond again. There was my grey-eyed friend, himself greyer, watching some cattle as they drank. "Bless me," said he, "I thought you were the inspector about the pond again." "Oh, no," said I, "what about it?" "Oh," says he, "since we met we have had a lot of inspectors. Gentlemen say there oughn't to be no roadside ponds. But Beauty here," fondly patting the cow next him, "and I knows better. It's a way water has about here to run into hollows and bide there. 'Very natural,' Beauty thinks, I'll be bound, and very convenient," he said. "Couldn't do without. Some on 'em is all for getting it away. It won't go though. All for the best, and I am much obliged to them all the same," said he. "How are the Hares?" said I. "Oh, all gone, cottage and all. Canvas Hare, as we call him, went to the union at last. Where do you sleep to-night — not at the 'Bulldog'? Good people, though, at the 'Bulldog.' Come with me." We entered a small farmhouse. The passage and the room floor were of stone, clean as the delf-plates on the dresser. A white cloth was laid on an old oaken table with carved oak legs. Upon it were set a home-made loaf, a cheese and milk, and a mug of home-brewed beer. They were waiting. "We'll say grace," he said; and we sat down three generations of us. The village carrier was there; the mug of beer was for him. In ten minutes we had finished. I observed that little was said during our meal. All rose. "The Lord be praised," he said. In a minute the few plates were gone. A Bible was set down before each of us. My grey-eyed friend began to read, "Blessed are the poor in spirit: for their's is the Kingdom of Heaven." We all read the first part of the Sermon on the Mount, each a verse; with just an occasional literary catastrophe from the youngest and from the carrier. Then the head of the family knelt and prayed a short prayer and rose. "You will sleep here," he said. "Is the room ready, Jane?" "Yes," said she; "and I hope the gentleman won't wonder if he hears us moving about in the morning." "Oh! no," I said, "I shall be up early too." "But it's churning morning," said Jane; "sisters and I begin churning at Three. That's early for such as you. You see, sir, we like to get churning done before the day's work begins at Six." "Do you see the empty chair there?" said the father; "that's her Mother's," said he; "tain't empty though exactly. The children all thinks she is there, and tries to do as she did or would wish them now. That keeps them up, you see. It's our way in Lowmarsh—always was. Don't know how it will be. They disputes so now. They's always making new laws. They've given up bidding us be law for ourselves as they used. It's all very well about cottages; I hold to 'em. But these Hares, the good ones was good in a bad cottage, and the bad one would be bad in a good one. Why, if those old maids was angels they couldn't love one another more than they did. One's gone home. Some on 'em came from London and held a meeting off the Plough t'other day. They said they was just come to throw over the parson and take the land and the farmers and the landlords and the whole lot of us. Many of them said 'Hoorray! come on!' They kept to that some time. Then the good lot said, 'Why, if you don't do your best as you be now, you won't be no better off then. Seems to me,' says he, 'they that does their best is most ways happy.' Nobody's let alone, sir, now. With their politics and their disputings, life's all a fighting to the end. There is no peace, nor won't be this side of the churchyard. And then? ——"

Jane, who had been standing by the door, an old brass candlestick in her hand, smiling said, but half reprovingly, "Father, you know quite well every one's happy, if he finishes his churning before the day begins."

I observed she now said, "Finish churning before *the day* begins." She first had said "before the *day's work* begins." She now left the room, and I think she meant to give an answer to her father's faltering question, "And then?" And I think she meant "when our *life's work* ends, perhaps daylight begins." But I don't know how this may be.

I went to bed, and half woke as they went downstairs at Three. I know I then muttered "Won't be no rest till the churchyard," and "You have to finish your churning before the day begins." However, I went to sleep again, as we often do while others churn.

I resolved, though, to write one day what I had to tell about Village Health; this resolution was not one of Dante's, as these pages have shown. I wish I could as easily express what I owe to the lessons of Lowmarsh, and to the example of the poor.

If any gentle Reader has had patience to follow this slight sketch of Village Health through its dark hints and its dry details, he may perchance find his interest increased in the problem of Village Life.

For under the word VILLAGE, as we now understand it, even with the limitation of an agricultural, as distinguished from a mining, or a fishing, or a manufacturing village, there lie problems of deep significance in the evolution of society, whether in Indian communities, Teutonic, or British. It suggests much in the history of property and in the future of the English people. I have not striven to conceal these deep questions, nor yet have I had the rashness, just now, or here, to discuss them. The movement, indeed, of the Rural and the Urban populations of England, as Dr. William Ogle has remarked to me, is one of the gravest subjects of our country districts and of our towns. It is not to be lightly written of. The Local Government Board and the Registrar General's offices are amassing facts and drawing inferences, such as, until the last few years, were unattainable, and such as will form the sound basis of much Social thought.

As regards the other word, HEALTH—Health *personal*, Health *national*, or that wider kind, *comparative* National Health, which looms large in the biological science of the future, and which treats of the development, the inheritance, the tolerations and adaptations of our race, and which lies closely allied to, and at the root of, those strange problems in comparative pathology, that are concerned with the causes and prevention of diseases common to the rest of the animal world and to man, or communicable from them to ourselves, I have not sought to veil my profound conviction, that while the material surroundings of man are important factors in the formation of his character, it will be a fatal plunge for any people that think that these alone can regulate their happiness or guide our Higher Nature to its appointed end.

IV.

Readers approaching the subject of this Paper for the first time may find the following Books useful as an introduction thereto :—

Handbook of Hygiene and Sanitary Science. By Dr. George Wilson.

Annotated Model Bye-laws of the Local Government Board. Knights.

Dangers to Health. By T. Pridgin Teale.

Observations on the Construction of Healthy Dwellings. By Captain Douglas Galton.

Village Communities. By Sir Henry J. Maine.

The English Village Community. By F. Seebohm.

The Sanitary Condition in City and Country Dwelling Houses. By George E. Waring.

Village Improvements and Farm Villages. By George E. Waring.

Village Politics. By C. W. Stubbs.

Public Hygiene in America. By H. J. Bowditch.

Handy Book of Cottage Hospitals. By Horace Swete.

Use and Influence of Hospitals for Infectious Diseases. Annual Report of the Local Government Board, 1880–81.

State of the Dwellings of Rural Labourers. By Dr. Hunter. Report of Medical Officer of Privy Council, (7th), 1864.

Report Public Health Act (1875) *Amendment Bill,* April 5, 1878.

The Dwellings of the Labouring Classes. By H. Roberts.

The Cottage Register. Forms for Registering the Sanitary Conditions of Villages. By Dr. Acland, F.R.S. (Parker, Oxford).

A Manual of Practical Hygiene. By E. A. Parkes.

Personal Care of Health. By E. A. Parkes.

NOTE ON REGISTERS OF COTTAGES.

After the Horwood Fever, to which allusion has been made in the text, it seemed to me that the first step to a complete reform of the condition of Cottages, of Villages, and of Artizans' dwellings in urban and suburban districts all over the kingdom, would be to obtain a Register of their condition.

With such a Register on his table, every Surveyor, Landowner, Clergyman, or Medical Officer would have the facts of the case before him.

The Form which here follows has been in use in some districts for many years, having been first issued in 1861. Extended knowledge has made me more than ever desire to see the use of such Forms universal.

Each leaf represents one Cottage. Every Cottage should have the door numbered to tally with the Register.

Any intelligent person can fill up the Forms. A village carpenter can fill in the record of a village in a day or two.

Every Vestry, Local Board, or Health Authority would find it very convenient to keep such Registers in its office.

The various Public Health Acts, imposing, as they do, the detailed charge of the Public Health on the Local Authorities, make it more than ever desirable that all Local Officers of Health should possess such records for reference of the state of the Cottages, Hamlets, and Villages within their districts. There is no doubt they do now possess such accounts more or less systematically over the whole country, either themselves or by means of their Sanitary Inspectors. It is not therefore so much for Authorities that I venture to take this opportunity of recommending these or some such Registers, but for owners of Cottage Property.

These Forms have been sold at cost price by Messrs. Parker, of Oxford, in covers with 50 and 100 leaves (or cottages) in each book. Every owner of cottages therefore can, and should, have such a record on his table. A benevolent and able landlord lately discovered by a systematic enquiry that he had near his own house sixty cottages without a fireplace in any bedroom. This fact alone may excite many non-resident owners to ascertain exactly in this simple way the state of every house. What he is to do is of course another and further question. To have the knowledge is one help to the solution.

FORM OF COTTAGE REGISTER, EACH LEAF IN A VOLUME OF 50, OR 100, REPRESENTING ONE COTTAGE.

*Date*________________ 18 .

PARISH OF____________________ COTTAGE, NO.__________

Situation____

Owner____

Tenant.	Employer.

			Ages.				
Married ?	Children.	Boys.					
		Girls.					

Number and Dimensions of Rooms used as

Bed-room.	Living-room.	Wash-house.
ft. by . high.	ft. by . high.	
ft. by . high.	ft. by .	
ft. by . high.		

What rooms have fireplaces ?

Windows ?		How many square feet of glass ?	Can they open fully ?	Are they near the floor or ceiling ?	Are there windows on opposite sides of Cottage ?	
In bedroom	1					
	2				*Upstairs*	
	3				*Downstairs*	
In down-stairs rooms	1					
	2					

Is there a porch, and back-door ?

Are there, or when were there, any Lodgers ; and how many, Male or Female ?

Condition of Drainage and nature of Privy, Earth-closet, or analogous arrangement ?

Pig-sty?

Surrounding Ground drained, or capable of Drainage?

State of Repair?

Probable Cost of repair?

Is the Cottage worth repair, or would it be better to rebuild it?

Is it wanted in the Neighbourhood, or had it better be placed elsewhere; and where?

Water-Supply.
  Well.
  Spring.
  Tank.
  Conduit.
  Quality.
  Nearness to Cesspool or Drain.

GENERAL REMARKS.

Under this head may be recorded any social or other memoranda.

*Estimate made by*____________________

Report { *made by*____________________
Report { *examined by*____________________

HEALTHY
NURSERIES AND BEDROOMS,

INCLUDING THE

LYING-IN ROOM.

BY

MRS. GLADSTONE.

CONTENTS.

THE NURSERY.

CHAPTER I.

INTRODUCTORY. 101

CHAPTER II.

SITE OF THE HOUSE.

PAGE
Aspect—Soil—Surroundings—Air—Light 105

CHAPTER III.

INTERNAL ARRANGEMENTS.

Number of Rooms—Drainage—Change of room—Carpets—Fittings—" Seaside lodgings" 107

CHAPTER IV.

FRESH AIR.

Fresh Air—Avoidance of chills—Temperature—Removal of dirty linen—" Tired Air"—Ventilation—Cubic space—Curtains—Ceiling—Walls—Carpets. 110

CHAPTER V.

WASHING AND DRESSING A BABY.

Temperature of bath—Fireplace—Soap 115

CHAPTER VI.

CLOTHES.

PAGE

Damp—Irritation from soda—Maintenance of heat—Keep head cool—Shade—Perambulators—Chills 118

CHAPTER VII.

HABITS OF ORDER AND NEATNESS, AND MORAL TRAINING.

Tidiness—"No place like home" (especially the Nursery)—Discipline of the nursery—Discipline of the instincts . . 121

THE SICK-ROOM.

CHAPTER I.

SITUATION.

Aspect—Sunshine—Isolation—Two rooms at least—Drainage—"Sanitary Maxims" 124

CHAPTER II.

INTERNAL FITTINGS AND ARRANGEMENTS.

Walls — Material — Colour — Pictures — Carpets — Curtains — Windows—Quiet—Noiseless Crockery—Cleaning—Screens . 128

CHAPTER III.

BEDS.

Height—Two beds—Stretcher on wheels—Moving a patient—Bedding—Spring mattrass—Valances—Curtains—Footboard—"Self-ventilation"—Pillows—Position of bed—Screens—"Crumbs"—Wrinkles in the sheets—Bed-clothes—Quilts—Counterpanes—Temperature of bed 131

CHAPTER IV.

TEMPERATURE AND VENTILATION.

Temperature—Ventilation—Tobin tube—Open fire . . . 136

BEDROOMS IN GENERAL.

PAGE

Aspect—Isolation—Ventilation—Tobin's tube—Inlet and Outlet of air—Equable temperature—Early morning hours—Thermometer—Dry scrubbing—Carpets—Furniture . . 138

THE LYING-IN ROOM.

Child-bearing not a disease, but easily running into disease—Mortality—Favourable circumstances—Unfavourable circumstances—Average results—"Preventible deaths"—Some of worst dangers generally avoidable, but not always—Who take chief responsibility?—General bearing of drainage, ventilation, &c.—Aspect—Quiet—No previous infection in room—Noiseless crockery—Two rooms at least—Fire in nurse's room—Bed—"Two beds better than one"—Protection of bed—"Guards"—"Drawsheet"—How to move a patient—Nurse's dress should be clean and look clean—Disinfection—Rings—Nails—Sleeves—Skirt—Hand-washing—"Childbed Fever"—Its nature—"Antiseptics"—Their Objects—(1) Condy's Fluid; (2) Carbolic acid; (3) Corrosive sublimate—Directions for their use—Arrangement of the washstand 142

PREFACE.

EVERY real and searching effort towards knowledge and improvement will surely make us long for more. It is, therefore, with great pleasure that I offer this small contribution to the International Health Exhibition, in the earnest hope that those who are generally interested in the subject will come with the serious intention of carrying away as much information as possible.

This Handbook, one of many that are issued at the present moment for the same purpose, treats of the proper management of Nurseries, Bedrooms both for the sick and healthy, and Lying-in rooms. In offering it, no apology on my part is needed, for the strength of this little Handbook lies in suggestions derived from many valuable authorities on the important subjects in question, coupled only with some practical observations founded on my own experience. The little Work can therefore lay claim to a very small amount of originality; but for the purposes of the International Health Exhibition it is thought well to bring together in a convenient form information derived from many trustworthy sources.

In introducing to the public the following pages, I have to acknowledge with many thanks the assistance of a dear niece, who has ever been closely associated with me in any little work of mine connected with Hospitals, Convalescent Homes, and Orphanages.

I am greatly indebted to Dr. Champneys for his help throughout, and especially for the chapter on Lying-in

Rooms, which is almost entirely his own. I have, in addition, largely quoted (among others) from Coombe (on Infancy), Dr. W. B. Richardson,[*] Mr. Pridgin Teale,[†] Dr. Squire,[‡] Mrs. Leslie Stephen,[§] and Mrs. Craven, better known as Miss Florence Lees, who, to quote my friend Dr. Acland, is, in her genius for nursing, second only to Miss Nightingale.

CATHERINE GLADSTONE.

May, 1883.

---

[*] 'Good Words,' 1880.

[†] 'Dangers to Health.' Churchills, 1883.

[‡] "Health in the Nursery and School," in 'Our Homes, and how to make them Healthy.' Cassells.

[§] 'Notes from Sick-Rooms.' Smith, Elder, and Co.

HEALTHY NURSERIES AND BEDROOMS.

THE NURSERY.

CHAPTER I.

INTRODUCTORY.

MUCH advance has been made of late years in the intelligent care of children. It is not so very long ago that strange doctrines prevailed even among the superior class of nurses as to the danger of fresh air and of soap and water; while many and grievous were the fashionable medicines that held sway in the nursery. Many such habits and maxims have now been swept away; nevertheless much has still to be learnt, and many bad practices have to be corrected, especially among the middle and lower classes.

It is with much diffidence that I offer a modest contribution to the discussion of the management of nurseries, having no greater claim to be heard than arises from the practical experience of many years, and the advantage of much valuable advice from the late Sir Charles Locock.

I well remember that eminent physician presenting me, more than forty years ago, with the little book 'Combe on Infancy,' and saying as he did so, "Do not only read it, but learn it by heart." His advice has often been of service to me, and often have I had reason to thank my kind old friend, while children and grandchildren have been springing up around me.

At the present "railroad pace" of life, a few practical suggestions, put together in a convenient form, may prove more useful than longer and more elaborate dissertations.

Let us then enquire at once, What is of most practical importance for the preservation and development of infant life? And what intelligent reasons can be given why certain conditions are good or bad? This will naturally lead us to turn our attention to the healthy arrangement of nurseries, recognizing the primary importance of the subject, with a view to the well-being of the little ones.

In this matter knowledge and affection should go hand-in-hand; instead of which, how often ignorance leads to grievous mistakes, even among loving mothers who would lay down their lives for their children, the very affections leading to harm rather than good.

Trouble should be taken by every mother to make herself acquainted with the laws and principles governing the human body: she should learn the vigilant watchfulness without which she will never succeed in understanding the tender organization of her child; thus constitutions will be strengthened and lives saved. Instead of walking by uncertain paths in the dark—now over-coddling, now over-bracing—practising experiments haphazard on the delicate little frame, the mother will be guided aright, for the laws of nature will be taken for her guide. And so beautiful and so full of interest are these laws, that surely, even if their study involves some sacrifice of time, it will become a pleasure, as it becomes a duty, and there will be ample compensation. For it is the Almighty Hand that we must recognize, writing upon the very nature of the child these laws of its being, and the more closely we follow that guiding Hand, the more clearly shall we learn that the highest wisdom lies in seconding and assisting Nature.

And here I will make no apology for quoting at some length from the author to whom I have already referred—Andrew Combe—for his words form a better introduction to this little Paper than any remarks of my own.

"The development of the human faculties, and the formation of human character, take place according to fixed laws imposed by the great Creator for the regulation of both mind and body: our part must be to work in conformity with the Divine arrangements. By fulfilling the condition, under which any organ or function is intended to act, we may modify or improve its action, but we cannot alter the nature of the function itself. In education, accordingly, it is indispensable to success that we adapt our means in such a measure to the nature of the being to be educated, that they may be in perfect harmony with the laws of its constitution, so that the laws may themselves become the instruments, as it were, of attaining the result. In ordinary life, however, this principle is,—chiefly from ignorance of the human constitution,—wholly overlooked, and we hear even sensible men talking habitually as if they could implant or eradicate any quality of mind at pleasure, adopting in practice, at the same time, the most heterogeneous methods to accomplish their purpose. To make this clear to the reader, let us take an illustration from eyesight.

"The sense of sight acts under a definite constitution devised for its regulation by the Creator. It is one law, or portion of that constitution, that a certain quantity of light is indispensable to a healthy vision. . . . If from wholly disregarding the laws of organization and of vision, we neglect to regulate our training by their dictates, and confine ourselves to *pointing out to the intellect* the advantages of quick vision, disappointment must follow; we may strengthen the reasoning powers by such means, but we shall do nothing to improve the faculty of sight. Precisely the same rule applies to the moral and intellectual faculties. Each and all are implanted in us by the Creator with different functions, and we cannot add a new feeling or a new power by any means. . . . Man will never stand in a right position towards Almighty God, or towards His fellow-creatures, till he regards himself and the world around him, as placed from the beginning in a definite relation to each other, and governed by laws emanating from wisdom and beneficence it is impossible for him fully to scan; it is for him humbly to study, and gratefully to venerate, admire, and obey. If he does this, and seeks in the simple spirit of faith and truth to fulfil the plan marked out in legible characters by the Finger of Providence on the laws of the animal economy, he will reap comfort and improvement from his endeavours. But if he presumptuously step beyond his limit, and attempt to fashion man by laws and fancies of his own, he will not less assuredly and deservedly reap pain and trouble for his reward."

CHAPTER II.

SITE OF THE HOUSE.

Aspect—Soil—Surroundings—Air—Light.

WE will begin with the consideration how best to secure a *healthy abode* for children.

It is evident that the first thing to do is to make a wise selection of situation and aspect, though as to this of course people are not always able to choose. We are, however, planning an Ideal Nursery. Let us begin, then, by securing, if possible, a southern aspect. Sunshine has undoubtedly an effect, upon children especially, akin to that of pure air; it brings on its rays life, and health, and joy.

Those who live in towns will be amply repaid, even from an economical point of view, by the choice of a dry situation, rather than one which is low and damp. For the children of the poor, especially, under-fed and over-crowded as they mostly are, how great is the importance of this point! The matter is often disregarded through ignorance or selfishness; houses are run up in unhealthy spots, and no attention is bestowed on the nature of the soil, or the vital question of drainage.

The country is, of course, preferable to town; yet a country house too closely surrounded by trees, or in the neighbourhood of stagnant water or undrained marsh, may have a sickly and melancholy nursery history.

In a very valuable paper by Dr. Squire,* we find the following remarks:—

" Whatever has been said of the general requirements of a house, it is in the nursery where all that is most essential to health and comfort should be most perfectly represented. The active man, whose duties for the greater part of the day call him abroad, sooner forgets his fatigue, and has his strength for renewed activity more thoroughly restored, where a healthy home awaits his return. For those who have to spend most of their time within, from duty or necessity, the greatest care in all the details of a wholesome dwelling are most wanted. The strong man, after free respiration out of doors, may pass through foul or damp air in the basement of the house with the inner breath of his capacious chest untouched; he may sit in a close hot parlour without enervation, or sleep in a chilled bedroom without his vigorous circulation being seriously depressed. Not so those who stay at home; from these evils even the strong would suffer; delicate women, susceptible youth, tender childhood suffer most. The mature and robust bear cold well, so that the air be dry and pure; the young must have warmth. Another necessity for those much indoors is light. No room can be healthy, however well calculated for its inmates, unless, in addition to the requisite air-space, the air it contains is being constantly renewed; this is ventilation. Most important of all those requirements is cleanliness."

---

* 'Health in the Nursery and School.' By W. Squire, M.D., F.R.C.P., p. 6.

CHAPTER III.

INTERNAL ARRANGEMENTS.

Number of rooms—Drainage—Change of room—Carpets—Fittings—"Seaside lodgings."

THE words just quoted from Dr. Squire bring us to our next point, namely, the internal arrangements of our children's homes; with regard to which let us bear in mind that much may be done even where we cannot have perfection, by adapting and contriving things to the best advantage. If possible, however, two rooms at least should be devoted to the nursery, so as to ensure constant change of air, without risk of chills, and plenty of scrubbing without exposing the children to the dangers of damp floors.

"Sanitary defects in dwellings are most plainly shown in spoiling the health of children; the young suffer soonest from bad air, noxious vapours, damp, dust, and want of cleanliness. Into houses where the children are lively and well we may be sure no sewer-gas enters; this may not be the particular cause of illness where children are sickly, but some violation of sanitary law will be found that checks healthy development." *

While bestowing all possible care upon the main points of drainage, ventilation, &c., let us be careful not to neglect the little every-day precautions without which children brought up in palaces may and do fall victims to the very same blood-poisonings that are chronic in the slums. For instance, there should be the greatest care as to trapping; the slightest blocking up often neutralises the good of elaborate ventilation.

"Children are the better for frequent changes of room; they have to spend most of their time in the house; they

---

* Squire, p. 3.

require short intervals between their meals, with quick transitions from play to rest. The meals should be taken where there is no litter of toys; a quiet room is needed both for work and sleep. Means of getting change of air, and of taking exercise within-doors or under cover, are essential. In town houses of moderate size, the best place for welcome change is the drawing-room; it is often the largest room, and the infant may well spend some time there; all the children, under supervision, may be familiar visitors.

"Home life to the younger members of a family and to the gentler sex means that by far the largest part of every day must be spent indoors, and half of it—at least for the very young—in the bedroom. No attempt should ever be made to rear children in a single room. The necessity of providing a full supply of pure and fresh air in youth, when change and growth are most active, is obvious." *

Again, few carpets should be used, and those easily removed out of the way for the rooms to be scrubbed. Here we may again quote some very apposite remarks from Dr. Squire's pamphlet, pp. 1, 4:—

"The details of nursery *fittings* must vary extremely in the different grades of society, while many of the same details of nursery *management* can be commonly carried out; the principles to be kept in view are the same in all stations of life, and may often be as well observed in the poorest as in the richest dwellings. No amount of grandeur will keep mansions free from noxious gases; the most costly chamber soon becomes unhealthy if constantly occupied."

"Children thrive best with free and frequent access to the outer air; no attempt should be made to render any suite of apartments for the young independent of this, and any arrangement that makes it difficult for children to get out of doors is to be avoided."

A warning may here be given as to the risks often run at the seaside and other health-resorts. Under the impression (a most delusive one in our climate) that "the children will be out all day," indoor arrangements are often left very much to chance. We have known children stowed away in the smallest possible space, no thought taken about drainage and ventilation, and thus the benefit of the change of air almost, if not altogether, neutralized, and the sacrifice of time and money so cheerfully undergone for the sake of the trip entirely thrown away. Or a house will be carelessly taken which has been infected by scarlet fever, or some other disease, with disastrous and sometimes fatal effects.

---

* Ib., p. 6.

Our nurseries should be on an upper floor; in fact, the higher the better, only we should avoid placing them directly under the roof; an arrangement which secures the maximum of cold in winter, and of heat in summer.

CHAPTER IV.

FRESH AIR.

Fresh air—Avoidance of chills—Temperature—Removal of dirty linen —"Tired air"—Ventilation — Cubic space — Curtains — Ceiling — Walls—Carpets.

ONE of the first points to be considered, with the view of promoting a baby's healthy development, is respiration.

Every time we breathe, we take in an influence either for good or for evil, according to the quality of the air which surrounds us. As so large a part of infant existence is necessarily spent within doors, we ought never to lose sight of the fact that every moment of our lives is influenced by the air we breathe. Again, we must remember that "The blood is the life"—its action affects every part of the organization—how important, then, is the supply and the quality of the blood, and how necessary it is to know that pure air contributes to its health and nutritive power. To prove this, we have but to notice the wonderful revival of a poor little child when removed from some foul, vitiated atmosphere, and permitted to breathe sweet fresh air.

On this point, let us quote the words of one who speaks with all the authority of a great name—Miss Florence Nightingale—(it will be seen that she has a word of warning for foolish extremes, while earnestly advocating pure air). "It is all nonsense what some old nurses say, that you can't give a baby fresh air without giving it a chill; and, on the other hand, you *may* give a baby a chill which will kill it (by letting a draught blow upon it when it is being washed, for instance, and chilling its whole body, though only for a moment), without giving it fresh air at all; and depend upon this, the less fresh air you give to its lungs, and the less water you give to its skin, the more liable it will be to colds and chills."*

---

* 'Notes on Nursing,' pp. 90, 91.

Let us here strongly protest against the foolish fashion of half smothering a sleeping baby—covering its head and mouth, at the risk of stifling it outright. This is the more senseless, as, by common consent, babies' caps have gone out of use, presumably because the advantage of keeping the head cool has been recognized.

Cots and beds in the nursery should be uncurtained, or nearly so. We might almost as well lay the child to sleep on the shelf of a press, or at the bottom of a packing-box, as in a cot closely curtained round. An authentic story is told of a well-constituted child passing within a few minutes from a condition of spasmodic irritation bordering on convulsions, into perfect health, owing simply to the admission of fresh air into a close, ill-ventilated nursery.

A thermometer should be kept in the rooms, and should not rise above 60° F.; over-heating being as unwholesome as the reverse.

Nervous irritability is a prominent characteristic of infancy; and pure air will be found to act as one of the most powerful nervous sedatives upon the tender system of a child. Whatever, therefore, affects the purity of the atmosphere, should be quickly removed; proper places provided for dirty linen, &c. The air of bedrooms should be perfectly fresh, especially should we beware of "tired air" creeping in from the day nursery just before the children's bedtime: chimneys should be kept open, bed-clothes turned back as soon as the child is up, and exposed to the air for some time.

Following Miss Nightingale's example, however, in the extract given above, we must put in a word of caution against draughts. These can often be efficiently guarded against by the use of screens, and a little common sense should be exercised as to the position of the cots, the bath, &c.

We may here refer to two excellent little tracts, published by the Ladies' Sanitary Association, 22, Berners Street, called 'The Cheap Doctor,' and 'The Worth of Fresh Air.' Indeed, our readers could not do better than make themselves acquainted with the publications of this most useful society generally.

We again quote Dr. Squire :—

" The importance of careful and efficient ventilation of the rooms occupied by children can hardly be over-estimated. The air of a closed room soon loses its freshness even when unoccupied. Chemically the proportion of oxygen may not be appreciably altered, but the more active, or organized, part of it is changed ; innumerable particles are brought into contact with it which, if not ' stealing and giving odours,' may add what is imperceptibly injurious, and will certainly take away from it the quality of freshness. Movement of air through a room is a first essential of ventilation ; then the quantity and rate of movement has to be considered, taking care that the temperature and other qualities are so preserved as to be both pleasant and wholesome. . . .

" The efficient ventilation of a child's first nursery, under the special conditions of warmth required, demands a full allowance of cubic space to begin with. In calculating the necessary space for bedrooms, where equable warmth is required, any height exceeding ten feet is disadvantageous, and to be left out of account." *

" A room, 15 feet square and 9 feet high, affords ample initial cubic space for a nurse and two children ; with good and careful management, a nurse, infant, and two other young children have occupied a bedroom of this size without detriment to health. No useless articles of furniture or of drapery were allowed entrance ; both a dressing-room and a bath-room were close at hand, care was taken to keep the air of the room pure, no open vessels were allowed to remain, the door, never quite closed, admitted light and air from the passage, the two windows were partly open on the summer nights, and the fire always lighted before bedtime in the winter. Children from 7 to 9 or 10 years of age may have separate bedrooms, and after that age a separate dormitory for each is requisite. A space 14 or 15 feet by 8 or

---

* loc. cit., p. 21.

9 feet wide, permits of a bed 4 feet wide to be placed between the door and the wall, and a fireplace in the opposite wall to be beyond the foot of the bed. No double-bedded room should be less than 15 feet square, and no bedroom should be without a fireplace." *

"In well-arranged houses, a good supply of pure warmed air will enter the bedrooms from the staircase and corridors by spaces purposely left near the floor, or under the door; half an inch left under each door, or three-quarters of an inch at the top, obtained by bevelling the upper edge of the door would provide such spaces, which should together be equal to twenty-four square inches for each person; theoretically the inlets and outlets should be equal; practically, they equalize themselves whatever we do, and one or two grated openings may be placed in the angle of the walls and ceiling." †

"The room door may be left partly open, and there will mostly be an open door either from the dressing-room or the nurse's room; the doors must be so hung that when partly opened they will shield the bed, rather than direct the current of air on to it. The windows in the summer can be left a little open at the top; they should be provided with shutters, both to keep off draught and to shut out some of the light when this may be necessary; they aid materially in lessening the chill that in cold weather always strikes in from the windows. A stout linen or jute fabric makes a good protective window-curtain for the winter. All woollen hangings are objectionable in a bedroom, as they readily absorb moisture and all organic particles suspended in it or floating in the air. The ceiling of the room should be such as to bear rubbing over; it is better of a grey or cream colour than white, so as not to reflect too much light on the upward gaze of children. The walls of the bedroom are better distempered, or painted in some even tone of quiet colour; if the wall is papered, it should be varnished over, and the paper must have no bright-coloured intricate pattern-spots, and no vivid greens likely

---

* Ib., p. 25.

† Ib., p. 26.

to contain arsenic. The floor must not be carpeted all over, certainly not under the bed, and it is better to have the boards stained and left bare round the sides of the room; the top edge of the skirting-board should be rounded off in all rooms for children. Iron bed-frames should have round edges. Slips of soft carpet by the sides of the bed, and from the door to the fireplace, if not all over the centre of the room, are sufficient. Kidderminster carpets are better than those of more open texture for bedrooms, and Dutch carpets, with a smooth woollen surface over a hempen framework are specially suitable for children's rooms and the passages leading to them.

" The windows, except for bedrooms, should always be continued up nearly to the ceiling, and are better lofty than large. In the evening, when lights are burning, they may be opened a little near the top, with such arrangements of curtains as to protect those in the room from draughts." *

---

* Ib., p. 26.

CHAPTER V.

WASHING AND DRESSING A BABY.

Temperature of bath—Fireplace—Soap.

"IN small houses, while the family is small, the best rooms are very properly used as nurseries; the nursing is good, for it is directly under the mother's eye. Here some of the common cares and duties that make a good nurse are practically taught. The simple precautions thus learned are not always attended to when the nurse acts independently of the mother. Old custom lingers long in nursery matters, longest perhaps in the first traditional handling of infants, where the experience of the nurse has to be trusted to. The most 'experienced nurse' has to be distrusted; experience is often pleaded as an excuse for carelessness, or is a cause for the nurse's convenience coming before the welfare of the child. To some nurses it is too much trouble to use a thermometer for the infant's bath, they can tell if it is the right heat: if not, it has been said, the infant will cry and look red if the water be too hot, blue if too cold. They are slow also to consult the thermometer on the wall; they like the room to be warm, and prefer a bright light from gas or lamps, when the night-light is all that should be allowed."*

The temperature of the water used for washing an infant should be nearly that of the surface of the body—96° or 98° F. As the child grows older, the heat of the water should be gradually lessened, while the limbs should be allowed free exercise in a large tub. Some children do not bear cold water well; good sense, discrimination, and observation should be our guides in this as in all other matters.

---

* Squire, p. 4.

Vigorous rubbing after the bath contributes much to the health of children as they leave infancy behind them; of course, a baby's tender skin should be most tenderly dried. "It is soothed and protected by the use of violet powder after being washed. The best toilet powders are, in some degree, antiseptic, and are constantly improving in this direction. French chalk, white fuller's earth, or Taylor's Cimolia, already replace starch, and, instead of orris-root, eucalyptus oil, menthol, or boracic acid might be used in nursery powder; the latter is now in use under the name of sanitary rose powder." *

Care should be taken with regard to nursery fireplaces. Iron or wire guards are really indispensable, to prevent the terrible accidents which are only too common. It is, of course, well to wash and dress a baby near the fire, but mothers and nurses should never allow the child's eyes to be exposed to the glare of the fire, or its head to be heated. We should always bear in mind the delicate organization of an infant's eyes and brain, and the excitability of its nervous system.

"An infant no sooner breathes than the heat of the body attains the normal; the first differences of warm or cold felt by the skin, the first sense of touch, excite the requisite movements to bring air into contact with the newly-diverted blood current, and life goes on at a full rate. Respiration is aided by a child's first exertion in crying; washing and rubbing also afford an exercise beyond the muscular kicks and struggles excited; all these quicken change and tend to develop heat."

When a child is put to sleep, whether by night or by day, light and noise should be carefully excluded. Even when they do not prevent sleep they tend to render it unrefreshing.

"Children sometimes suffer fatigue or chill from the way in which they are first dressed in the morning; they require a biscuit or some milk as soon as they get up, and before the ablutions begin; it is much better to give them a

---

* Squire, p. 11.

general wash in warmed water, in which they could stand while being sponged over with cool or tepid water, than to chill them when their powers of reaction are at their lowest. The soap used should not be irritating from excess of alkali, or from impure and imperfectly combined ingredients. Babies most easily suffer from this, and also from want of care in the warmth of the water used, or from harsh rubbing." *

---

* Ib., pp. 8, 11.

CHAPTER VI.

CLOTHES.

Damp—Irritation from soda—Maintenance of heat—Keep head cool —Shade—Perambulators—Chills.

WE should be very careful to have infant clothing light, soft, and warm, varying with the seasons,—so adapted that it may be put on and taken off easily. Every mother should see that the dress will admit of expansion of chest and stomach, with perfect freedom for limbs and joints. "Much irritation is produced by keeping damp clothes close to the skin, and more when caustic soda has been used in washing and is left from careless rinsing and drying. All impervious wraps are to be avoided ; there must be frequent changes of linen." * The supply of animal heat in a baby being small, the dress should be chosen with a view to warmth, but whilst taking every care to give a comfortable and equal warmth, do not coddle or over-heat the child ; beware of loading it with too many clothes, and of covering the neck with warm shawls or tippets within doors. All that is wanted is to keep the upper part of the dress sufficiently high to protect the chest and arms, for over-heating is bad and relaxing.

Exceptional circumstances, of course, demand exceptional care ; for instance, in a case of premature birth, the preservation of vital heat is the one thing to be attended to ; it is safest to wrap the baby in flannel, or, as has been done with good effect, to imbed it in a basket of cotton wool, and not to expose it to the air at all—at all events not till the doctor comes.

Never overlook the tendency in young children at the period of teething, to nervous excitement. Keep the head

---

* Squire, p. 11.

cool. Avoid over-soft pillows, close wrapping-up of the head, and heavy bonnets or hats. How often, from affection and pride, a velvet hat is chosen, laden with feathers or trimmings, which oppresses the poor little head. Such things are objectionable both in winter and summer. We would also warn mothers against the turned-up hat; it is almost sickening to see the poor children in perambulators, with the sun's full glare beating upon the susceptible head and eyes.

Here we must allow ourselves a short digression upon the misuse of perambulators.

Very valuable in themselves, when used with proper attention and common sense, it is difficult to speak with any patience of the cruel folly so often seen in the use of them. There are the sudden jerks, the rushes at dangerous crossings, the poor babies left to sleep in every variety of unwholesome posture; these and other heedlessnesses expose children to the risk of chills, with all their train of evil consequences, sunstrokes, and even spinal injuries.

Nurses should exercise common sense, both indoors and at home, to guard against the opposite dangers of heating and chilling children. How often does the former practice lead to the latter result! Let us once more listen to Dr. Squire:

"Short contact with quite cold air or water is injurious to infants; prolonged exposure to the low temperature of a cold house or chamber still more so; most so when the air is not only cold, but damp. In houses otherwise healthy, the onset of acute disease in children, of inward congestions, glandular swelling, tubercle, dropsy, has started from the occurrence of unusually low temperature in their rooms, during exceptionally cold weather, when the means of maintaining sufficient warmth have been neglected, or applied with difficulty. Children are also to be guarded against sudden changes of temperature. After some days in a well-warmed room the first promenade should be short. A child of four or five years old cannot bear a long walk in cold weather, but soon tires, and is then still more liable to suffer from cold. Out of doors, children passing from a sheltered to an exposed position, the turn of a street, the draught in a passage, may get a chill ; or returning indoors, hot and excited from running or play, the wraps are all removed, though the room to which they have returned is only half warmed, perhaps has become too far cooled, from open windows or neglected fire, they catch cold more on coming indoors than on going out. An infant in arms is often chilled in this way ; closely muffled at starting out, carried near the nurse's body, under warm coverings, or shut in a carriage with closed windows, it is brought home, hot and perspiring, and laid down asleep (its load of clothes removed) on a cold cot in the chill quiet of the bedroom, while the other children prepare for dinner ; no wonder the youngest suffers first. Not only should the woollen clothes and coverings not be removed at once, but the chamber thermometer should be consulted. Prevention of illness is better than cure, and for both objects a thermometer in the children's room is indispensable." *

* loc. cit., p. 15.

CHAPTER VII.

HABITS OF ORDER AND NEATNESS, AND MORAL TRAINING.

Tidiness—"No place like home" (especially the Nursery)—Discipline of the nursery—Discipline of the instincts.

WE will now dwell shortly upon the importance of training the children themselves by means of good order and rules, and quiet, gentle discipline.

Children imitate before they can reason, hence the importance of setting them a good example from the first. How will it be, if instead of this, they get used to seeing articles left about, drawers open, untidiness in little daily matters?

On the other hand, what a picture of brightness and happiness is the well-ordered nursery! "A place for everything, and everything in its place,"—cheerful faces, freshness, innocent mirth. In these little ways, the training for the future, both of mind and body, is begun, developing as they do with the child's growth. A notion seems sometimes to prevail, that attention to trifling matters such as these, should be set aside, for the sake of more important considerations, but surely "these ought ye to do, and not to leave the others undone."

"Our first notions of home start from the nursery. Here, where all the wants of early life are met, healthy development soon leads to conscious comfort. The youngest child has this happy knowledge. Rooted in the nursery, it grows and gains upon us there. Children come to feel that food, rest, quiet, and pleasant ease belong to the place to which they are always brought back after all the changes that excite or tire, where some one shows them care and love, and the greeting of another self is sure. This kindly attention, with all around orderly, clean, and cheerful, not only makes childhood happy, but leads to strength, good nature, trust, courage, and virtue."

" Such elements of comfort and completeness in a house are always serviceable; no better accommodation could be offered to friends or visitors than what is designed for the most cherished members of a family. If happily peopled by children, this part of home becomes to them the dearest spot on earth. It may afterwards be the delight of children's children, the rallying-point or centre of a family, that shall attract its many members and hold them together, knitting the generations each to each." *

It is the wise and loving discipline of nursery days which lays the foundation of all that is pure, and good, and lovely, and strong, in the character of man or woman.

And thus we are led, before closing these few hints, to say a word or two upon that most serious, most vitally important subject, the moral influences of the nursery. Total ignorance upon this aspect of our little children's lives is only too common; and mothers, who anxiously "get up" all needful facts about the matters referred to above—ventilation, drainage, warmth, wholesome food, and clothing—never think of the watchful care, necessary from the first, to train aright the natural instincts, and what may be called the moral germs of the little being, whose immortal soul is unfolding in the midst, alas! of a world of sin and evil. Unutterable is the mischief that may be brought about by wicked, coarse-minded, or grossly ignorant nurses and nursery-girls. This is not the place to go into details upon so painful a subject; let it suffice to draw the attention of mothers to this matter, and earnestly appeal to them, as they love their little ones, to be on their guard.

Let us listen to the wise words of Dr. Elizabeth Blackwell:—

"The youth who has grown up from childhood under the guardianship of really wise parents, in a true home, with all its ennobling influences, and has been strengthened

---

* Squire, p. 5.

by enlightened religious instruction, has gradually grown towards the natural human type." And again :—

" The mother's eye, full of tenderness . . . . must always watch over her children. Self-respect *cannot be too early* inculcated. . . . . Every thoughtless breach of delicacy should be checked with a gentle gravity, which will not repel or abash, but impress the child. . . . . In work or in play, in infancy or youth, the parent [should] be the first natural friend." *

---

* 'The Moral Education of the Young.' Hatchards.

THE SICK-ROOM.

CHAPTER I.

SITUATION.

Aspect—Sunshine—Isolation—Two rooms at least—Drainage—"Sanitary Maxims."

LET us now turn our attention to the Sick-Room, and throw together such simple hints as experience may suggest; again reminding our readers that (though our subject is, indeed, one involving life and death) we must be brief and practical, and not aim at an exhaustive treatment beyond our powers.

Few are the hearts to whom this subject will not appeal; for who has not at some period or other of life known what it is to watch in critical moments over beloved ones stricken down with sickness? And how great is the pain, the mortification, the aching self-reproach which assails us when we are forced to realize at such moments our own "sins, negligences, and ignorances" in the matter of skill and watchful attention.

As in the case of nurseries, we would begin by suggesting a southern aspect as preferable to any other; the sick-room should be cheerful, spacious, and lofty, and we should bear in mind the invaluable effect of sunshine. In illustration of this, we may give an authentic instance. During the time of the cholera in 1853, it was observed that patients whose rooms were on the sunless side of the street mostly fell victims to the disease, whilst the inmates of sunny rooms frequently recovered.

As we must prepare, in every dwelling-house, for the contingency of illness, how desirable it would be for *all* houses, even of moderate size, to have some one corner suitable for a sick-room! If space admits of such a room being entirely isolated from the rest of the house, so much the better; but much may be done by at all events securing two rooms opening into each other, with windows, doors, and fireplaces where they should be, with hot and cold water supply within easy reach, and a closet properly placed.

All such convenient arrangements, however, will be useless, and worse than useless, if the drainage is imperfect; and upon this vital point, how much we have still to learn! It is not only in the crowded and squalid dwellings of the poor of our cities that poison-traps are laid; there are many luxurious homes where the horrors of bad drainage lurk unsuspected till typhoid, diphtheria, or other scourges seize upon their victims.

We are told by a great authority (Mr. Pridgin Teale, of Leeds, in the introduction to the first edition of his most valuable book, 'Dangers to Health"*) that "probably no work done throughout the kingdom is so badly done as work in houses, drains, and pipes, which is out of sight."

Such an alarming statement is hardly to be wondered at, when the author is able to assert, after much practical experience in the matter of drainage, that he is convinced "that probably one-third of the incidental illness of the kingdom, including perhaps much of childbed illness, and some of the fatal results of surgical operations in hospitals and private houses, are the direct result of drainage defects, and therefore *can* and *ought* to be prevented." With a view to such prevention, Mr. Pridgin Teale gives us a list of admirable "Sanitary Maxims," which we subjoin:†—

---

* Published by J. & A. Churchill, New Burlington Street.

† Copies of these "Maxims" can be obtained of the National Health Society, Berners Street. 2*s*. per 100.

1. It is the duty of every householder to ascertain for himself whether his own house be free or not from well-known dangers to health.

2. This duty, imperative at all times, is of surpassing urgency in a house where a woman is about to become a mother, or a surgical operation is about to be performed.

3. As a rule, the soundness of the sanitary arrangements of a house is taken for granted, and never questioned until "drain-begotten" illness has broken out. In other words, we employ Illness and Death as our drain-detectives.

4. Whenever gas from sewers, or the emanations from a leaking drain, a cesspool, or a fouled well, make their way into a house, the inmates are in imminent danger of an outbreak of typhoid fever, diphtheria, or other febrile ailments classed together under the term "zymotic," not to speak of minor illness, and depressed vitality, the connection of which with sewer gas is now fully established. Sewer gas enters a house most rapidly at night, when outer doors and windows are shut, and is then perhaps most potent in contaminating the meat, the milk, and the drinking-water, and in poisoning the inmates.

5. The more perfect the public sewers of a town, the greater the danger to every house connected with such sewers, if the internal drain pipes of the house be unsound, and not *disconnected.* In houses so misconnected sewer air is "laid on" as certainly for the detriment of health as coal gas for illumination; and *you can turn off coal gas at the meter.*

6. Every hotel throughout the kingdom, and in our watering places every house let as lodgings, ought to have its sanitary arrangements *periodically* inspected, and duly licensed.

7. A house in which children and servants are often ailing with sore throat, headache, or diarrhœa is probably wrong in its drainage.

8. Scamped drain-work is one of the most dangerous of the sanitary flaws of new buildings; it is also one of the most common, and one of the most difficult to detect, and is rarely found out except by the illness it produces.

9. If you are about to buy or to rent a house, be it new or be it old, take care, *before you complete your bargain,* to ascertain the soundness of the sanitary arrangements with no less care and anxiety than you would exercise in testing the soundness of a horse before you purchase it.

10. If you are building a house or can achieve it in an old one, let *no drain be under* any part of your house; *disconnect* all waste pipes and overflow pipes from the drains, and place the soil pipe of the W.C. *outside* the house and ventilate it.

11. If there is a smell of drains in your house, or a damp place in a wall near which a waste pipe or a soil pipe runs, or a damp place in the cellar or kitchen floor near a drain or a tank, let no time be lost in laying bare the pipes or drains until the cause be detected.

12. If a rat appears through the floor of your kitchen or cellar and a strong current of air blows from the rat-hole when chimneys are acting and the windows and doors of the house are shut, feel sure that something is wrong with a drain.

13. If you are tenants, and your landlord refuses to remedy the evil, *do it at your own cost rather than allow your family to be ill.*

14. Many a man who would be aghast at the idea of putting small quantities of arsenic into every sack of flour, and so by degrees killing himself and family, does not hesitate to allow sewer gas to poison the inmates of his house, even in the face of the strongest remonstrances of his medical adviser.

15. A landlord may reasonably look for interest on the money which he spends for the benefit of his tenant ; but he is committing little short of manslaughter if, by refusing to rectify sanitary defects in his property, *he saves his own pocket at the expense of the health and lives of his tenants.*

16. If you be a landlord, don't intimidate your tenants, or threaten to give them notice to quit if they complain of defective drainage or sewer gas in the house.

CHAPTER II.

INTERNAL FITTINGS AND ARRANGEMENTS.

Walls—Material—Colour—Pictures—Carpets—Curtains—Windows—Quiet—Noiseless Crockery—Cleaning—Screens.

If it is feasible to set apart rooms for sickness they should be painted rather than papered, for more than one reason. Papers, however pretty, are apt, if they have much pattern, to distract feverish patients, and even to give birth to delirious fancies; moreover there is the fear of arsenic in the colouring, or of unwholesome smell from paste; and the trouble and expense, after infectious illness, of stripping and thoroughly cleaning the walls, and hanging a fresh paper.

Plain distempering is as good a plan as any; it is wholesome, cheap, and simple, and easy of renewal. Cheerful tints should be chosen, avoiding colours which, while pleasant enough in the daytime, are swallowed up in gloom by candle-light. Nothing can well be more trying to an invalid than thus to be imprisoned in a vault-like obscurity. Pleasant pictures often give a favourable turn to weary thoughts; these or other objects can be hung up, re-arranged, or taken away, to suit the sick person's fancy.

As to carpets, the less we have of them the better; but if any are used, mere strips or rugs are best; as they are easily taken up and shaken, or cleaned. Curtains should be got rid of, especially if of woollen or stuff; cotton and linen should be used for any sofa or chair coverings.

The arrangement of the windows is an important matter. They should be made to open easily from both top and bottom, whilst some contrivance is necessary to prevent any rattling noise from either window-frames or outer blinds. And this brings us to the great importance of *quiet* in a sick-room. To secure this, nothing is too small to be noticed. Who has not felt the violent shock, unpleasant even in health, of the sudden falling of fire-irons? We have found walking-sticks a wise substitute for pokers, and housemaids' gloves invaluable in the place of tongs or scoops, as a means of noiselessly putting on coal, or of taking it off with the view of lighting a bright fire quickly.

"Noiseless" crockery in a sick-room has been till lately a desideratum, but it can now be obtained. The principle adopted is that of noiseless tyres to wheels, made of india-rubber. Such tyres are fitted to the bottoms of the jugs, basins, &c. The avoidance of clatter economizes the nerves both of patient and nurse, and the advantages are so obvious that no more need be said on the subject.*

If it should be necessary to clean the walls of the sick-room without moving the patient, it can be done quietly and efficiently, and with no raising of dust, by means of a damp cloth. When extraordinary quiet is necessary, there are many little plans that may suggest themselves to prevent all needless movements and disturbances. A screen may be so placed as to conceal any person who is obliged to pass to and fro, so that the invalid, during critical hours, may not be conscious of anyone being present, except his accustomed nurse, seated perfectly still at his bedside. By means of the judiciously-placed screen, any thing that has to be brought in can be quietly handed over the top without a sound. Door-hinges and handles should be carefully eased and oiled. As little furniture as possible should encumber the room. No wandering foot-stools, boxes, or baskets should be in the way, to be tripped over; no knick-knacks crowded on tables or mantel-pieces to harbour dust, take up room, or tumble down with a crash.

For our sick-room to be really a model one, we must overlook nothing—chimneys, grates, walls, ceiling, windows, doors—all should be attended to; while one special piece of furniture deserves a notice to itself, namely, Beds. We will, however, before closing the present section, quote a passage from one of Miss Yonge's charming stories,* which bears upon such small but important matters as we have mentioned above.

---

* "Vernon's Patent Noiseless China," is referred to.

The heroine is suffering from nervous fever, and has been made worse by the well-meant fussiness of her family.

" Rachel was exceedingly feverish. She tossed restlessly at night, and was depressed to the lowest ebb by day ; but, ill as she was, she insisted on seeing Captain Keith. . . . . So, as a desperate experiment, he was at last allowed to go into the dressing-room, where she was lying on the sofa. . . . . She did not look up, till she suddenly became conscious of a foot-fall, firmer, though softer, than those she was used to. She turned, and saw who it was who stood at a window opposite to her feet, drawing up the Venetian blind, *from whose teasing divisions of glare and shade she had been hiding her eyes. . . . . fretted by the low continuous tap of its laths upon the shutters.* Her first involuntary exclamation was a sigh of relief. 'Oh, thank you ! I did not know what it was that was such a nuisance.' 'This is too much glare. Let me turn your sofa a little way round from it.' And as he did so, and she raised herself, he shook out her cushions, and substituted a cool chintz-covered one for the hot crimson damask on which her head had been resting. 'Thank you ! How do you know so well ?' she said, with a long breath of satisfaction. 'By long trial,' he said, very quietly seating himself beside her couch, with a stillness of manner that strangely hushed all her throbbings ; and the very pleasure of lying really still was such that she did not at once break it."

This little scene shows a thorough comprehension on the author's part of how fevered nerves may be tranquillised by attention to small things.

---

* 'The Clever Woman of the Family,' p. 326.

CHAPTER III.

BEDS.

Height—Two beds—Stretcher on wheels—Moving a patient—Bedding—Spring mattrass—Valances—Curtains—Footboard—"Self-ventilation"—Pillows—Position of bed—Screens—"Crumbs"—Wrinkles in the sheets—Bed-clothes—Quilts—Counterpanes—Temperature of bed.

THE bed should not be high, or above 3½ feet in width. It is a great advantage to have two beds available, each of the same level, with mattrass, sheets, and blankets all complete, so that the patient on being moved from one to the other, can leave all the bedding he has used free to be thoroughly aired.

We have been told by Mrs. Craven (better known as Miss Lees, whose services abroad will be so long remembered and admired) that in the French hospitals a stretcher upon wheels is much used instead of a second bed, and there are surely great advantages in this plan. A bed can be made upon this, and the patient lifted on by the bottom sheet held by the corners, which can then be gently withdrawn; the stretcher is, of course, less cumbersome and more moveable than a bedstead. This bed on wheels would be very handy if the patient's health admits of wheeling him into another room.

Perhaps it is hardly necessary to allude to the state when on no account should the patient be moved at all, and yet it is well to be very guarded; there are conditions when even to sit up in bed might produce a fatal result, as for instance in diphtheria, cholera, typhoid fever, surgical cases after shocks, bad confinements or cases of hæmorrhage.

Feather-beds should be entirely banished; they are unwholesome for the healthy, and trebly so for the sick.

A thin but well-stuffed mattrass placed on a "chainmail" or spring bed is the best plan; but it is a little difficult to lay down a rule to meet all cases.

Valances and bed-hangings are all better away, with the exception of curtains of a washing material just at the bed-head.

It is often well to have a footboard against the usual iron or brass rail at the foot of the bedstead, so as to give the patient power to make some exertion with the least possible effort, by pressing the feet against the board or pulling upon a rope attached to it.

Mrs. Leslie Stephen, in an admirable little book, full of thoughtful good sense, and written in a pleasant, lively style ('Notes from Sick-Rooms'), says:—"A sick bed is apt to become close and unpleasant, but the nurse may refresh it without chilling the patient if she raises the top sheet, with the coverings resting on it, three or four times, thus fanning the bed and causing the patient no fatigue or chill. An invalid can air her own bed in this way if she can raise her knees; she need then only lift the outer edge of the sheet up with her hand and raise one knee up and down; but this of course requires some strength, and the bed will be more effectually aired by some one standing by the side of it.

"Some people think that the whole comfort of a bed depends on its pillows, and I am not sure that they are not right. Certainly a hard or a pappy pillow will make an otherwise comfortable bed a most unresting one. Every one has their own way of arranging their pillows: some like them smooth and straight, while others twist and turn them till it seems as if no head could find rest. The nurse must find out which way her patient prefers before attempting to arrange the pillows. I have often seen a sick person tormented by the over-zealous nurse seizing the pillow and altering what certainly seemed a most uncomfortable arrangement, but one which was, in fact, exactly suited to the patient's needs, and only attained after many struggles. The nurse must be always ready to turn the pillow when wanted; she can do this without fatiguing the patient, by placing one hand at the back of the sick person's head, while with the other she quickly turns the pillow and slips it back into its place. I say *hand* advisedly; the palm hollowed inwards a little should be used. Nurses very often make use of two fingers, which, when well pressed in at the back of the head, make the turning of pillows a very torturing process. Where no second pillow is at hand, and the patient wishes to have her head higher, she can make a comfortable change for herself by doubling the corner of the pillow back or under her cheek; but no nurse can attempt such an arrangement, as it may be such an uncomfortable one, that it is only by the patient's own hand and cheek that the proper curve can be made.

"If a waterproof sheet is necessary, the best way to make the bed is as follows: The bed having been made as usual, with a good blanket under the lower sheet, the waterproof should be laid on it, over the waterproof a blanket, and again over the blanket a sheet; these should not be tucked in. When the waterproof is no longer wanted, the top sheet, blanket, and waterproof can all be drawn away from under the patient, who will find herself on a clean, freshly-made bed."

Never place the bed against the wall: remember the great convenience of being able to get all round it without difficulty, of allowing the freest circulation of air, and of seeing at a glance that no dirt or dust, or other accumulations, have lodged near the bed.

If possible, turn the bed side-ways to the window, that the patient may not have to face the light; if this cannot be managed, there must be some rather elaborate arrangement of screens and blinds to protect the eyes. The best place for the bed is opposite the fireplace, not between the door and the fire. It should not be so near the door as to have it open, as it were, upon the patient.

Upon the matter of bed-clothes and pillows, and how to avoid certain minute miseries, we cannot do better than again quote Mrs. Leslie Stephen (pp. 5–11):—

"Among the number of small evils which haunt illness, the greatest, in the misery which it can cause, though the smallest in size, is crumbs. The origin of most things has been decided on, but the origin of crumbs in bed has never excited sufficient attention among the scientific world, though it is a problem which has tormented many a weary sufferer. I will forbear to give my own explanation, which would be neither scientific nor orthodox, and will merely beg that their evil existence may be recognized and, as far as human nature allows, guarded against. The torment of crumbs should be stamped out of the sick-bed, as if it were the Colorado beetle in a potato-field. Any one who has been ill will at once take her precautions, feeble though they will prove. She will have a napkin under her chin, stretch her neck out of bed, eat in the most uncomfortable way, and watch that no crumbs get into the folds of her night-dress or jacket. When she lies back in bed, in the vain hope that she may have baffled the enemy, he is before her; a sharp crumb is buried in her back, and grains of sand seem sticking to her toes. If the patient is able to get up and have her bed made, when she returns to it she will find the crumbs are waiting for her. The housemaid will protest that the sheets were shaken, and the nurse that she swept out the crumbs, but there they are, and there they will remain, unless the nurse determines to conquer them. . . . The patient's night-clothes must be searched; crumbs lurk in each tiny fold or frill. They go up the sleeve of the nightgown, and, if the patient is in bed when the search is going on, her arms should hang out of bed, so that the crumbs which are certain to be there may be induced to fall down. When crumbs are banished—that is to say, temporarily, for with each meal they return, and for this the nurse must make up her mind—she must see that there are no rucks in the bed-sheets. A very good way of avoiding these is to pin the lower sheet firmly down on the mattrass with nursery pins, first stretching the sheet smoothly and straightly over the mattrass."

Heavy clothes are always a mistake; *weight* is not the same thing as *warmth.* Light quilts or coverlets are invaluable. One eider-down quilt will take the place of two blankets. It should be remembered, and specially in illness, that weight means fatigue.

Counterpanes are objectionable: they allow no evaporation. One good rule is so to regulate the clothing, that the body is never cold, and yet never hot. The result of sleeping under too much clothing is, that the body becomes feverishly heated; this is not to be tolerated for the young, and is good for nobody.

It has been suggested that the head of the bed should be to the East, so that the body should lie in the line of the Earth's motion.

Seeing that no less than about a third part of our mortal life is spent in the bedroom (and that part the most helpless), how important it is that the room should be a very sanctuary of cleanliness and order, from whence all injurious exhalations should be banished, and all dirt and dust driven away.

It is most important not to neglect the materials of which pillows and bolsters, together with the mattrass, are made. Evil may spring from imperfectly dried feathers, or even (and how we shudder at the idea!) from feathers undergoing decomposition. It is said that little children are often made sleepless and restless from such causes.

We have spoken of ventilation in rooms, many may have never thought that the bed should be ventilated not less than the rooms. There are inventions of tubes so adapted to enter the bed, as at once to ventilate it. We refer to O'Brien's bed-ventilating tube. Dr. Richardson tells us that this tube ought to be fitted to beds in sick-rooms and wards in hospitals.

CHAPTER IV.

TEMPERATURE AND VENTILATION.

Temperature—Ventilation—Tobin tube—Open fire.

UNLESS the doctor gives special orders to the contrary, the temperature of the sick-room should average from 60° to 65° F. and should be carefully regulated by means of a thermometer hung near the bed. (For operations, the temperature is usually maintained at 70°; but we are not speaking of exceptional conditions.) Common sense should guide the nurse, however, in these matters; no general rule should be absolutely hard and fast, but should be modified according to the individual case; for instance, when the circulation is very feeble, and the vital energies are low, a warmer atmosphere will be advisable.

Never ventilate the room from the passages alone; it is better to have the temperature a little too cold, than to admit foul air; the air a sick person breathes should be as pure as the external air.

For ventilation without draught, a close wire-netting will be found very useful—fitted into the top of an ordinary sash window; or a simple piece of zinc pierced with small holes will answer the purpose.

It is often perplexing to procure freshness without chill or damp upon foggy or wet days. An excellent method appears to be employed in Canada, and is also sometimes seen in this country. A bar of wood, three or four inches deep, is exactly fitted to the bottom of the window frame, so that the lower sash on being closed, rests upon it: this causes an opening in the middle of the window, between the two sashes, so that a current of air enters, and is directed *upwards.* If the top sash is also lowered an inch or two, we shall gain a ventilator at the top as well as in the middle of the window. This plan will be found as simple as it is efficacious. A 'Tobin tube'* placed in a corner of the room admits air much in the same way.

An open fire is an excellent means of ventilation. All must have noticed how much *sweeter* a room with a fire is than one without, though both may have the windows shut. We are told, on good authority, that a single open fire, in certain states of wind, will draw from the room 1000 cubic feet of air per minute; an ordinary briskly-burning fire requires 600 cubic feet of air per minute, and will, it is needless to say, obtain this supply, by hook or by crook, even in a closely shut-up room. Of course, however, this does not prevent over-heating of the temperature; and it is always well to have an open ventilator in every room where a fire is burning.

We should banish unnecessary articles of furniture from sick-rooms, as each displaces a certain amount of air and collects dust.

The head of the sleeper should not be higher than the throat of the chimney: this ensures his being in the current of the purest air.

---

* See p. 39, 'Bedrooms in General.'

BEDROOMS IN GENERAL.

Aspect—Isolation—Ventilation—Tobin's tube—Inlet and Outlet of air—Equable temperature—Early morning hours—Thermometer—Dry scrubbing—Carpets—Furniture.

ALTHOUGH much that has been said upon the subject of sick-rooms applies equally to bedrooms for the healthy, it will be as well to add a few words on bedrooms in general. For it is well to remember that greater care in sanitary matters while we are in health would often deliver us from sick-rooms altogether.

The south-west aspect is the best for all bedrooms. Winds from that quarter are the most genial, thus a room with this aspect can be most frequently and wholesomely ventilated by open windows during the day. The longest period of light and sunshine is also secured.

It is desirable that the bedroom, during the time it is occupied, should be shut off as completely as possible from the rest of the house, so as to avoid what may be called an *exchange of emanations.* Too often do we find that bedrooms are actual traps, in which is stored up the air of the lower or neighbouring rooms, charged with all the gaseous and vaporous products manufactured during the day. Under these circumstances, unfortunate people go to bed in an atmosphere consisting mainly of their own emanations, not to speak of gas and other impurities.

Whilst, however, pointing out the extreme evil of sleeping in foul air, we fully allow that satisfactory ventilation is often a matter of considerable difficulty. "When people can be induced to overcome their unreasoning fear of an open window, they not only tolerate it, but like it in the end. For much of this fear we have to thank the energetic but wisdom-lacking apostles of fresh air, who will burst into a room, violently throw up the lower half of the window, letting in a sheet of cold air, scattering papers, furniture, peace and comfort, in all directions, and increasing tenfold the prejudices they seek to remove." * An open window undoubtedly *may* introduce too much glare and noise ; and how many, to whom quiet refreshing sleep is everything, have to make a choice between two evils ! All that can be done is to endeavour to adapt things ingeniously to meet conflicting difficulties. Let one or two bricks be removed in the outer wall, beneath the flooring, then carry up a wooden tube (communicating by means of this aperture with the open air) in a corner of the room to a height of 6 or 8 feet. This tube, which is known as "Tobin's tube," should be 4 inches square, and would be suitable for a moderate-sized room—say 18 feet by 14, and 12 feet high. Should the current of air be very strong, the top of the tube may be covered over with gauze or muslin. If possible, it should be at a distance of 6 feet from the bed, which should be protected by a light washing curtain at the head. In some houses it may not be difficult to carry such a 4-inch tube through the whole length of a partition-wall, from the top to the bottom floor ; by which means a supply of air will diffuse itself through every room.

Ventilation, such as we have described, may suffice for the night ; but upon rising, let the window be opened at the top and bottom equally ; and, except when the weather is very wet, let it remain open till sunset.†

"The impure atmosphere, being the lighter, ascends, and leaves the room by the open window, and its place is taken by fresh air, which will find its way in by the cracks and crevices of the doors and windows in sufficient quantity.

"Sometimes a tiny piece of the *lower* sash is raised, about an inch ; a mode of ventilation that is . . . . a fruitful cause of stiff-necks, muscular rheumatism and the like, by letting in a wedge of cold air." *

---

* 'A Handbook of Nursing,' p. 170, by Cath. Wood. (Cassell's.)

† It happens sometimes, though but very rarely in our English climate, that in the height of summer the heat of the outer air is so great, that to ensure coolness at night it is well to close window and shutter all day, and only open them after sunset.

Shut the door when the window is open; it is far better to let the air enter only from the outside.

A good *escape* of air must be as much considered as ingress for fresh air. A simple method is to have an opening in the chimney-shaft near the ceiling; where there is (as there ought *always* to be) a fireplace and shaft, the opening for the exit of air up the shaft may be protected by an Arnott's valve.

We pass on to the advantage of maintaining an *equable* temperature in the bedroom, especially when the occupant is not robust. In our desire for air, we may rush into danger. We are told, on the authority of Dr. B. W. Richardson (whom we have already quoted), that many illnesses come from neglect as to the temperature. Take the case of an enfeebled person, who has sat all day in a warm atmosphere, and who goes to bed in a room without a fire; the result is, that in the early morning, say about four, when the temperature of the air in all parts is lowest, the room has become cold to an extreme degree, affecting a delicate person very seriously. When asleep, we are unconscious of this change; but we are told that between midnight and six the animal heat and vitality are at their lowest ebb. "The influence of the life-giving sun has been longest withdrawn from man, and the hearts which are even the strongest beat then with subdued tone."—(*Richardson.*) How much care and good sense are necessary, lest in our desire to brace and harden, we lose sight of prudence. Such considerations are, of course, especially important for old or delicate people, but even in the case of persons in ordinary health, they should not be overlooked. At the same time, the advantage of bracing, and the disadvantage of luxurious habits, should not be overlooked. The bracing system, when it can be safely borne, often has the happiest effect in strengthening and invigorating the system. The thermometer is in many cases kept at about 56 °F. with advantage. The thermometer should hang at the bed head, about two feet above the level of the pillow; it should be studied a short time before bedtime, and should not fall much below 60°, or rise above 62°.

---

* 'A Handbook of Nursing,' p. 170.

Scrubbing with sawdust is a capital plan. Use a small pailful of clean fresh sawdust, taking it out by handfuls, spread it on the place, and with a hard brush scrub with the sawdust as if you were using water.

Carpets nailed down and hugging the wall are objectionable; but strips of carpet and rugs are to be recommended, both for protection to the feet, and for causing footsteps to be noiseless; they also make a great difference in the charm and comfort of a bedroom.

As to the walls, we would refer our readers to what has been said with regard to sick-rooms. But we may here add a warning against the hanging up of perhaps rather time-honoured and travel-worn garments on the walls and doors, a habit which often accounts for a *fusty* atmosphere.

Having now lighted, ventilated, warmed, and carpeted our bedroom, we must end by *furnishing* it. Upon this point, we would not be as rigidly particular, in a general way, as it is necessary to be in cases of illness. It is only in great luxurious mansions, where even guests are given separate sitting-rooms, that we have no need of our bedrooms except for sleeping in. It is very depressing, after a tiring day, when one is not inclined for company, to have nothing but a bare, cold, empty room to take refuge in, with no appliances for reading, writing, or even *dozing* in comfort, and perhaps, as has been known, with no possibility of light, except a gas-jet projecting over the chimney-piece, thus obliging a reader to sit with his back to the fire. Let us plead for a well supplied writing-table, one or two small tables for candles, books or work, and above all, for a good comfortable, restful arm-chair.

A bedroom should be a very sanctuary of peace, comfort, and repose, "where we can take refuge from the cares and worries of life, so as to emerge refreshed and invigorated for our daily work."—(*Richardson.*)

THE LYING-IN ROOM.

Child-bearing not a disease, but easily running into disease—Mortality—Favourable circumstances—Unfavourable circumstances—Average results—"Preventible deaths"—Some of worst dangers generally avoidable, but not always—Who take chief responsibility?—General bearing of drainage, ventilation, &c.—Aspect—Quiet—No previous infection in room—Noiseless crockery—Two rooms at least—Fire in nurse's room—Bed—"Two beds better than one"—Protection of bed—"Guards"—"Draw-sheet"—How to move a patient—Nurse's dress should be clean and look clean—Disinfection—Rings—Nails—Sleeves—Skirt—Hand-washing—"Child-bed fever"—Its nature—"Antiseptics"—Their objects—(1) Condy's Fluid, (2) Carbolic acid, (3) Corrosive sublimate—Directions for their use—Arrangement of the washstand.

WE now direct our thoughts to that period, perhaps the most interesting in a woman's life, when she enters upon new responsibilities, new hopes and fears, new joys and sorrows, as her first child awakes to life.

Child-bearing is a natural process; but for this fact a lying-in woman would necessarily be considered as the subject of disease. The reasons for this statement are that (1) surgical injuries (that is, wounds, smaller or greater) almost invariably occur; (2) she is exposed to great risk, is (so to speak) either on the edge of a precipice, or series of precipices, or on an inclined plane, down which she may at any time fall or glide.

The mortality of childbirth is far greater than has been supposed. About one woman in 120 dies within the month, and probably about one in 100 eventually dies. This implies great risk, but the dangers of the first labour are considerably greater.

These figures include, of course, all emergencies, all neglected cases, all accidental deaths, all cases in which the mind has necessarily depressed the body, all cases in which motherhood is looked forward to with shame instead of with pride. Among such cases the mortality is larger than we have stated.

On the other hand must be put the healthy labours, the carefully-tended cases, the emergencies and accidents foreseen and guarded against or successfully combatted—the cases in which the surroundings are all that love, money, and skill can provide. Among these the mortality is less, and the experience of our readers will naturally be principally derived rather from the latter than from the former class. Nevertheless, the two large classes, *taken together*, give the figures which we have stated above.

What is the rate of mortality among the latter class has never been determined. It is sufficient now to say that skill and care are of paramount importance, and that many of the greatest dangers are largely under control. The mortality even in this latter class is called "preventible." To some extent this is true, but there is no prospect of its ever being eliminated. In spite of these facts, fear of danger never has scared, and never will scare, women from becoming wives and mothers.

Childbirth, then, although the gate through which all enter into life, is a very anxious process; the risk is run by the parents, and the responsibility therefore rests with them, and only in a very minor degree with the medical attendant, who does his best to steer safely through the shoals. A physician who has "never lost a case" is one who either has had few cases to lose, or who——deceives himself.

(3) The third element of danger is that many diseases contracted by the lying-in woman are apt to run an unusually severe course.

The moral of all this is not fussy interference, but the greatest care of all surroundings.

What has been said in the previous chapters on the subject of drainage, ventilation, &c., holds good with increased force with regard to the lying-in room. Not very long ago air was regarded as a great element of danger, and was carefully excluded; the room was kept very hot and the patient unwashed. The result must have been past description. There can be little doubt that it is now less dangerous for a woman to bear a child than it was then.

With regard to drains, the same applies; imperfect drains are worse than no drains at all; and, although "child-bed fever" is not caused by sewer-gas, sewer-gas may be the cause of fever in child-bed. It is within our own experience that a distinguished physician insisted on the presence of the plumber to remedy a defect in the lying-in room, even though labour had already begun.

With regard to aspect, the same rules apply as to ordinary bedrooms; but quiet is so much more important than light, that it should be thought of first. This applies especially to large towns.

The lying-in room should therefore have a southern aspect by preference; it should be spacious and airy, and shut off from the rest of the house.

We cannot say too much upon the subject of *perfect quiet;* it is all-important. Care should be taken to prevent rattling of windows and blinds. A smoky chimney would be most objectionable. To prevent noisy footsteps, strips of carpet should be judiciously placed about the floor.

Mistakes are often made from the notion of its being desirable to "amuse" the patient. It cannot be too much impressed upon all concerned, that the newly-made mother has her *thoughts* most busily employed with the new blessing that has been bestowed upon her. Let her lie still, saving all her strength for her tender maternal duties; do not harass her with questions about the Christening, and the Godparents, and the baby's name; keep away relations and friends; let only the very nearest and dearest visit her, and let *them* content themselves with sitting quietly in the room, when allowed to do so.

The remarks already made about crowding the room with furniture, carpeting it up to the wainscot, heavy curtains and hangings, removal of soiled linen, &c., should not be forgotten.

It is hardly necessary to say that care should be taken that no infectious case has occupied the room. In the absence of this, it is quite unnecessary to perform the antiseptic scrubbings, fumigations, &c., which have been lately suggested on high authority, although these are quite proper in a Lying-in Hospital.

"Noiseless crockery" need only be again referred to.

At least two rooms, *en suite,* and each with a separate entrance, are necessary ; one for the patient, the other for the nurse and baby. In the nurse's room a fire should be constantly kept burning. The temperature should be that of a nursery ; 65° Fahrenheit is not too warm for a new-born baby, 60° is about the right temperature to aim at after a short time, and it should be equably maintained by frequent reference to a thermometer. For further details with regard to this room, we refer our readers to the chapters on the Nursery.

The directions with regard to beds, already given, are generally applicable here. "Two beds are better than one" (to distort an old proverb). A spring or chain mattrass, and an absence of feather-beds are essential.

Some special directions, however, have to be given with regard to the protection of the bed.

Above the mattrass should be a macintosh sheet, extending from the pillow to below the knees, or even down to the bottom ; on this lies the lower blanket, and on this the lower sheet. Two "guards" and a "draw-sheet" should be prepared. The "guard" is a blanket folded so as to extend from the shoulders to the knees, and enclosed in a sheet, forming a more or less square, large, and very absorbent pad. On this the patient lies, and it is removed when soiled and replaced by another, either during or after the completion of labour. When the risk of much soiling is over, a "draw-sheet," folded so as to be about three feet wide, takes the place of the guard ; it can be gradually pulled towards the right side of the bed as wanted. All this time the bed runs no great risk of being soiled, and should emergency (such as flooding) outwit these resources, the mattrass is still guarded by the macintosh sheet.

When all risk of soiling is quite over, it is well to dispense with this also, as being impervious to perspiration it sometimes causes irritation of the skin.

If one bed only is available, the patient is, after a day or two, changed from side to side, which gives some refreshment.

The easiest way of moving a patient from bed to bed, or from bed to sofa, is to place the two side by side, *head to foot*, the patient can then be taken up and laid down without walking round the bed. This need only be thought out if it does not at once explain itself.

During the labour it is a capital plan to have the upper sheet turned up over the counterpane at the right-hand side of the bed and secured with nursery pins, so as to turn the upper bed-clothes into a sort of German quilt, a word which probably recalls memories to many of our readers, of nights in which they have woke half frozen and half baked, or, like old family pictures in the shop windows, half restored. This arrangement, however, is only temporary, and useful only during the progress of labour.

A word about the nurse's dress. All good nurses are well drilled in this respect during their training, and are proud of their uniform, but it would be well if the rules of some nursing sisterhoods could be revised with regard to dress; dark woollen dresses may be mediæval and ecclesiastically correct, but they are objectionable hygienically.

A nurse should wear nothing which cannot be washed thoroughly, and which does not "show the dirt" and require to be washed frequently. After any case which has not gone quite satisfactorily, she should include her stays in the list of purification, either by boiling or by baking. She should wear a neat white cap; she should not only be clean, but she should look clean. She should wear no rings. Her wedding-ring (if she possesses one) should be removed when she washes her own hands and the patient. Rings harbour dirt, damp, and other objectionable things. Her nails should be cut almost to the quick. Her sleeves should be capable of being turned up above the elbow. She should wear no jingling things, should have silent shoes, and a skirt that clears the ground.

The subject of hand-washing implies more than soap and water, and leads us to speak of "antiseptics."

"*Child-bed fever*" is the great danger that threatens a lying-in woman. Child-bed fever is blood-poisoning, and blood-poisoning is believed to be connected with the growth of certain microscopical living organisms in the body.

Antiseptics have for their object (1) the destruction of these living organisms; (2) the prevention of their multiplication in the body.

Our only means of effecting these objects is by attacking them before they get entrance into the blood and tissues, after which we cannot kill them without killing the patient.

The three most practical antiseptics are—(1) Condy's fluid (permanganate of potash); (2) carbolic acid; (3) corrosive sublimate (mercury perchloride).

Condy's fluid is well known. It should be used of a claret colour (about a teaspoonful to a pint of water), but its strength or weakness is unimportant. When used to a foul wound it turns brown, when the purple colour remains, the foulness is removed. It should, therefore, be used till its colour remains unchanged. A weak solution used for some time acts as well as or better than a strong solution used for a short time. The objection to it is that it cannot be used with soap. It is, therefore, not well adapted for antiseptic hand-washing, but a bottle of it should be kept in the room.

Carbolic acid is an excellent antiseptic, and has stood the test of experience. It destroys infection in 5 per cent. solution (1 in 20), and prevents it in 2½ per cent. solution (1 in 40). There are 20 ounces in an *imperial* pint, one ounce of *the best* pure carbolic acid in such a bottle filled up with hot water, and labelled "Solution of carbolic acid (1 in 20), *Poison*," should be kept on the washstand. For washing the hands this is the proper strength, and hands should be washed in the following way: The sleeves should be turned up half way to the elbows, the hands and wrists should be well washed with warm soapy water, and the hands (without rings) and nails scrubbed with a nail-brush ; they should then be well rinsed, and the hands and nails again scrubbed in carbolic acid solution, 1 in 20. No nurse should ever wash her patient after labour without doing this before and afterwards either with carbolic or corrosive sublimate solution. To pour a little of such a solution into a basin of water either for herself or the doctor shows that a nurse has had no proper training in antiseptic ways. A nurse who uses carbolic lotion properly, has hands and wrists of which the skin is always branny. This appearance is not beautiful, but it is a valuable security.

For washing the patient the strength should be 1 in 40; easily made by adding to a measured quantity of the stronger solution an equal quantity of water.

Corrosive sublimate is probably the best of all antiseptics. It can be used with soap, irritates the skin less than carbolic acid, is far cheaper than it, and is effective in very dilute solution. A strength of 1 in 1000 has the properties of carbolic lotion 1 in 20, and a strength of 1 in 2000 those of carbolic lotion 1 in 40. It should not be kept in very strong solution, as it is a strong caustic and a dangerous poison.

In conclusion, the arrangement of the washstand may be usefully described.

There should be two basins, a large and a small. The large basin is for soap and water, the small for antiseptic lotion. A good nail-brush is needed. On the washstand should stand a bottle of solution of carbolic acid (1 in 20), or of corrosive sublimate (1 in 1000), each properly labelled, and marked "*Poison.*"

Both basins should be prepared for the doctor.

HEALTHY

AND

UNHEALTHY HOUSES

IN

TOWN AND COUNTRY.

BY

WILLIAM EASSIE, C.E., F.L.S., F.G.S., ETC.

WITH AN APPENDIX ON THE

WATER SUPPLY AND DISPOSAL OF SEWAGE OF COUNTRY HOUSES.

BY

ROGERS FIELD, B.A., M. INST. C.E.

CONTENTS.

CHAPTER I.

HEALTHY AND UNHEALTHY SITES.

PAGE
Inspection necessary—Healthy sites—Geological bearings—Conditions of subsoil—Tidal valves—Subsoil draining—Aspect and prospect of houses—Aspect compass—Precautions against dampness—Underground ventilation—Dry rot, &c. 153

CHAPTER II.

ARRANGEMENTS OF HOUSES.

Classes of houses—Air spaces and examples of same—Improper distribution of services—Inlet and outlet ventilation—Escapes of smoke and gas in houses—Testing for escapes of lighting gas 168

CHAPTER III.

HOUSE DRAINING.

Brick drains and their dangers—Inroads of rats—Pipe drains—Iron drains—Errors in laying down underground drains—Inspection chambers—Cesspools, &c.—Disconnection of house drains—Disconnection chambers—Flushing of drains—Testing of house drains and pipes 181

CHAPTER IV.

TRAPS, SINK AND BATH WASTES, SOIL PIPES AND CLOSETS.

Traps used in house drainage—Grease collection chambers—Waste pipes from sinks, baths, and lavatories—Soil pipes—Water-closets suitable for a house—Slop closets 205

CHAPTER V.

PAGE

RAIN WATER COLLECTION AND DRINKING-WATER SUPPLY.

Rain water collection—Rain water pipes and abuse of same—Necessity for disconnection from drains—Utilization of rain-water—Filtering of rain-water for ordinary uses—Apparatus for heating water—Drinking-water supply and storage—How house water is fouled—Cisterns—Supply pipes—Filters—Hard waters 222

CHAPTER VI.

CONCLUSION.

Duties of a house seeker—Necessity for an inspection of houses in every detail—Duties of landlord and tenant—Caution as to taking houses without competent examination 241

APPENDIX.

Water supply—Quantity required, &c.—Sources of supply—Rainfall—Underground water—Springs—Wells and cesspools—Contamination of deep wells—Effects of pumping—Rain-water from roofs and filtration of same—Water supply arrangements generally—Disposal of sewage—Application of sewage to land—Sub-irrigation and examples 246

HEALTHY AND UNHEALTHY HOUSES

IN

TOWN AND COUNTRY.

CHAPTER I.

HEALTHY AND UNHEALTHY SITES.

THE wisdom of not entering upon residence in any old house until its healthy condition is vouched for by some competent authority, it would be a work of supererogation to affirm, seeing how many sicken and perish for want of the most ordinary care in this respect. In town and in country alike, when this precaution has been neglected, Nemesis, in the form of some indisposition or another, is certain to overtake the careless occupant. This axiom is unfortunately applicable to modern houses built within the present decade, as many a sorrowing heart can testify.

Residents in houses may be divided into four classes :—
1. Those who have built and dwell in their own tenements.
2. Those who occupy the house of another upon lease.
3. Those who have only a yearly tenancy ; and 4, those who take up residence for a very limited space of time only. The last-mentioned order of householders generally soonest suffer, possibly because they have just vacated a healthy dwelling. Without going so far as to assert that a person can reside for any length of time whatsoever in a dwelling which unmistakably violates sanitary rules without suffering for it, it is nevertheless often apparent that some can exist in palpable health in houses with very faulty

arrangements, where others would soon become indisposed if not seriously ill. Whether it is because the former are robustly healthy, and can defy the surroundings within which they move, or whether it is owing to their having become, so to speak, acclimatised therein, I do not seek to determine. But I question whether a pathologist would endorse either of these hypotheses; and I rather believe that he would, on the contrary, declare his conviction that evil of some kind or another must—although with celerity insufficient to make itself readily visible—sooner or later overtake any one who thinks he can continue to disregard with impunity the laws of health, by persisting in occupying a dwelling which those laws have in any respect condemned. It may be taken for granted, without entering into the details of the why and the wherefore, that some persons are more liable to incur disease than are others; but it is foolish to argue, as many do, that they could occupy a faulty building for any time without experiencing evil effects. I do not think it would be wise in this brief essay to discriminate in any way between long or short periods of residence in houses, whether in town or country. I will therefore confine myself to a relation of the main conditions which stamp a house as being healthy or the reverse, and this in the simplest language. No such words as "pythogenic poisons," "mephitic vapours," or "lethal gases," will be found in these pages.

The shortcomings of house builders vary very much, as a matter of course, some having been, and still being, terrible sinners against the goddess Hygeia, while others may be classed as almost venial offenders. It may be remarked, however, that the failings of any house in respect of healthiness are attributable either (1) to the improper site chosen for the dwelling; (2) to the evil arrangements of the house consequent upon faulty planning; (3) to bad drainage, to the presence of cesspools, to unsound plumbing, to the want of disconnection and ventilation of the drains; or (4) to a poisoned water supply. Within this circle will be found to move all the delinquencies which make themselves manifest in loss of health, sometimes culminating in death itself. Throughout these pages the dwelling will be treated generally, whether it be in town or country, because the faults or virtues of a house are almost identical wherever it may be situated. But those points at which they are occasionally found to vary will be specifically treated in the following pages.

Fairly healthy sites upon which to build houses can be provided upon any of the geological formations, or it would be a very serious matter for those who have no choice, and who must continue to reside where their occupations compel them. Nevertheless, some strata are healthier than others, and the wealthier classes, and those who are retiring from business, can exercise fastidiousness with regard to choice of a site for their dwellings. Some very curious facts present themselves relative to the question of sites which may be worth considerable attention. The earliest civilised people on our island chose the outcroppings of only certain geological formations to almost the entire repudiation of others. Mr. Topley, of the Geological Survey, mentions several interesting proofs of the truth of this statement. In the eastern part of Northumberland, the ancient villages and hamlets were built only upon certain isolated areas of a certain sandstone. Out of twenty-three villages, thirteen were built upon rock, six upon sand, and one only upon the clay. It has also been pointed out that "no less than nineteen of the largest and most important towns in England, from Exeter to Carlisle, are all situated along the line of one geological formation, the new red sandstone."

The importance of taking into consideration the geological formation upon which to erect a dwelling for posterity, and so form in time an ancestral estate, has not been very long recognised, but this subject is every day claiming more and more attention, and it will soon be impossible, perhaps, to discover a mansion which has been built upon an unsuitable site and abandoned afterwards, owing to its unhealthiness. There are several generally accepted axioms with regard to healthy sites which are in every one's mouth when speaking upon this point. They say that buildings erected upon the mountain limestone, the oolites, on sandstones, and well drained sand beds, are built upon dry ground; that if built upon marlstone and the like the subsoil would be termed moist; and that if placed upon the lias or on alluvial ground, the soil would be unmistakably moist. Then, again, it is common enough to hear even dry formations objected to by persons as variously affecting their health. Some cannot thrive upon the chalk, others dislike the silurian. Some, again, cannot exist upon the "rab" soils of Wales, while yet others become affected when residing upon soils largely volcanic in formation, and nothing but a change to other strata will restore them to their usual health. This all points to the necessity of taking into consideration the most suitable districts for the purchase of family estates, and for domiciling the invalid. It is certain that the matter deserves the attention which it is receiving at the hands of physicians. To show how susceptible some organisms are compared with others, a case has occurred where a blindfolded man led along the stone pavements in London when there was no traffic, early in the morning, was able to detect the presence or absence of asphalte in the streets in some occult manner.

Not only is it apparently important whenever possible, to choose for a place of residence a district which commends itself to the comfort of the seeker in regard to its geological conditions; but there are also other considerations which ought to be taken into account, if all points relating to health are to be comprehended. It is possible to make choice of a suitable formation and yet find it to turn out, from its position, a very unhealthy one.

Mr. A. Haviland, after years of study on this matter, has pointed out that districts which are situated on the coast and most exposed to the prevailing winds, and where the latter meet with the least obstruction, there is in such districts the least mortality due to heart disease. Whilst those coasts on the south coast which present barrier-like rocks, which interfere with the full sweep of the sea breezes, are to be identified with a high mortality.

The East Yorkshire group of counties which is bounded by precipitous oolitic and chalk cliffs, and has no inlets, with an inland-directed watershed, has a high mortality. From Whitby to Bridlington Bay, which answers the above conditions, there is, therefore, a high death-rate ; while between Bridlington Bay and the Isle of Sheppey, where there is a low coast of sea-board, offering no check to the winds, and a sea-directed watershed, there is a low mortality. Taking London, as a division, it has a low mortality, and co-incident with this, it will be seen that it is traversed by the great valley of the Thames, up which the winds can freely blow.

Another example of how the geological conditions of a tract of country affect health, has been instanced by Dr. Buchanan after his examination of the counties of Surrey, Kent, and Sussex, with regard to the distribution of phthisis or consumption there. He found that there was less consumption among populations living on porous soils than among those living on low-lying pervious soils. He also discovered that less phthisis existed among populations living on sloping impervious soils than among those living on flat impervious soils. Taking these counties as an example, the conclusions arrived at, and which he considers may now be affirmed generally, are to the effect that wetness of soil is a cause of phthisis to the population living upon it.

Very few indeed have it within their power to make a deliberate choice of the district in which they mean to reside to the rejection of others, and some have no sort of choice all their lifetimes. It therefore becomes incumbent upon the latter to pay sufficient heed to those lesser but nevertheless important points which regulate the conditions of health, no matter in what districts their lot may be cast. It will be found that the wetness or the dryness of the subsoil is the most important matter with which they have to deal.

It would be impossible in this Handbook to deal with any details, especially with regard to the very varying classes of subsoil, and I will therefore make choice of two, viz., gravel and clay. It will be unnecessary to notice boggy land, marshy bottoms, and the like, as undesirable sites for houses, because the thing is evident. Most people have a predilection for gravel as a subsoil, and this is mainly commendable, when the gravels are high-lying and deep, and cover a large extent of area, with a sloping impervious lower placed bed. But there are such things as "pocketed" gravels, and instances of this occur frequently in town and country. Professor Ansted has shown that a drift gravel fairly free from clays and loose sands, may in the main be healthy; but if the gravels be found in combination with boulder-clays, or are of common river origin, it would be well to avoid such a site in house building. Permeable gravels and sandy soils, such as our Bagshots, are healthy, and impermeable clay soils unhealthy; but it would be wiser to erect a residence on the hard clay soil, and trust to concrete between the floors of the house and the clay, than to erect the house on the absorbent gravel, resting on non-absorbent rocks, because these rocks form a barrier to drainage—with rare exceptions—and the result is an infiltration of surface and other impurities into the wells, and the supersaturation after a time of the subsoil, causing corresponding offensive emanations.

By common consent, clayey soils are considered the most unsuitable for building upon, not so much because they are damp, as because it is difficult to provide against the occurrence of cracks and settlements in the walls of houses built upon loamy clays, on clays alternating with beds of sand, or on clays between the various beds of which water is found to percolate. I have come across very serious slips in the clays upon which houses have been built in London, and notably on the Hornsey and Finchley Road districts, necessitating heavy expenditure to make good the fissures in the walls, and the loss of the true perpendicular. In respect of health, clay is not the worst kind of material on which to build, provided that the house is built upon a bed of concrete, and that, if necessary, the subsoil under the house is drained, just as one would drain a field. All the ordinary conditions of health can be fulfilled even upon a clay soil. Dr. Letheby has proved that clay soils are more exempt from cholera, for instance, than any others—likely enough, because a retentive clay cannot collect stagnant water or escaped sewage, but conducts them to a lower ground. What is true of one clay, may be taken as true of all other clays in these respects, whether belonging to the London, Wealden, Lias, Carboniferous, or Silurian.

It is somewhat difficult to decide by the eye and touch, whether a soil is a clay loam, a strong clay, or a pure clay; but there is one easy method of doing so. If 100 grains of the soil be treated in a graduated test-tube by mixing it with water and shaking it, and the sediment leaves from 40 to 70 grains of clay, it is a loamy soil; if from 70 to 85 grains are left, it betokens a clay-loam; when from 85 to 95 grains are left, it is a strong clay soil; and when no sand can be separated, it must be termed a pure clay.

Inasmuch as it has been proved, that all towns and villages which have been drained into sewers, have resulted in increased healthiness owing to the removal of water present in the subsoil, it follows that where the subsoil, upon which a house is to be built, betrays a presence of wetness, or secretes water in any way, it should be drained, in just such a manner as a farmer drains his meadows in order to get rid of rushes and other useless growths. When the site of the proposed house is chiefly running sand, or when the land is somewhat swampy, or full of springs, the water can be removed from the subsoil by common agricultural pipes. Or this excess of water can be taken into the ordinary drain of the house; but if the subsoil is to be removed in this latter manner, the drain pipes which collect and remove the subsoil water must be disconnected from the soil drain by a trap, and by an open exposure of the subsoil water before entering into the trap.

In country houses, it is very common to see cellars flooded out to a depth even of some feet during rainy seasons, and this cannot but affect the health of the inmates prejudicially. This state of things is nearly always found in houses which are built in the near neighbourhood of rivers subject to floods. Nor is it an uncommon thing to find gratings in the floors of the cellars, in direct communication with drains from closets.

If it be a serious matter to make choice of a dwelling on such a site as this, it is still more so to live in the neighbourhood of a large tidal river without having adopted proper precautions, when such dwelling is in communication with a river subject to floods by way of the house drains. In many places the river water with its contained sewage is forced back into the house, and when the flood has abated, a thick film of filth will be found upon the floors. In London, I have seen a kitchen at Queen Anne's Gate containing water some three or four feet deep, which had come from the Thames by way of the sewer, and in this case I was obliged to introduce a tidal-valve to resist the influx of water until the river had fallen. These tidal-valves have been known for years, and the first one constructed on sound principles was that by Sir Robert Rawlinson in 1854. An example of the best tidal-valve that I know, which I used at the house previously alluded to, and which has acted most satisfactorily, is that of F. Dyer of Camden Town, shown at Fig. 1. It will be seen to be constructed of a valve chamber, containing a copper ball held by a rigid arm, and so arranged that it cannot possibly fail to find its proper seating when the tide-water is rushing up the pipe A, and is pressing up the ball B against the surface of the pipe C which drains the house. I have made use of a similar contrivance in the Isle of Wight—of course enclosed in a chamber giving access—and have been

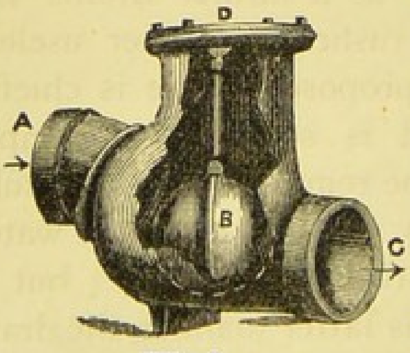


FIG. 1.

able to keep out the sea, when its stormy level has been some five feet above the surface of a cellar floor which was formerly flooded out for days together. Contrivances of this description are most useful in many districts subject to floods and high tides. From the foregoing remarks it may be gleaned that it is unwise to build on water-secreting soils unless special precautions have been taken by way of subsoil drainage with a proper outlet, or by employing water-resisting media such as the above. It is especially unwise to construct a deep cellar where subsoil water can enter. Sometimes, as in the case of the chalk and oolitic formations, these with their numerous fissures are relied upon to keep a deep cellar dry, and they will do so very generally. Although when unfortunately any cesspool of a country house is treated in a similar manner, and simply excavated in the chalk without rendering it watertight, there is apt to be an unpleasant connection between the floor traps in the cellar from which the water seal has evaporated during the dry season and the neighbourhood of the cesspool. It may here be stated that subsoil water can be utilised for flushing out drains at a lower level, and that combined pipes such as that shown at Fig. 2 are to be purchased, where the larger and upper pipe A which is rendered watertight at the joints conveys away the sewage, whilst the lower pipe B is used for the draining of the subsoil waters.

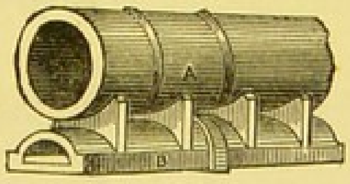
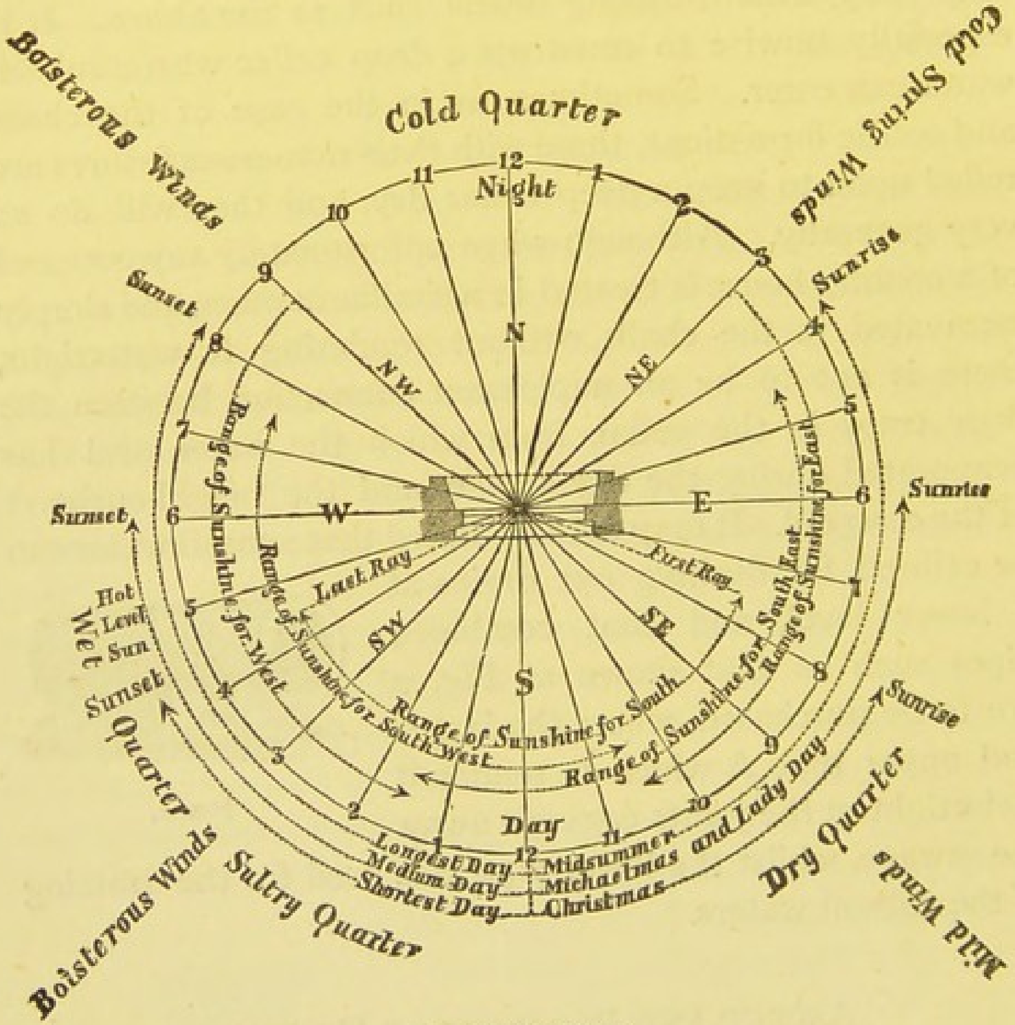


FIG. 2.

ASPECT AND PROSPECT OF HOUSES.

I must here devote a short space to this subject, for it is one of considerable importance. Aspect and prospect have more to do with comfort in house building than is commonly admitted, inasmuch as a house may be designed so as to realise the full beauty of the scenery, whilst the plan adopted may bear no suitable relation to the weather and the daily course of the sun. The question of "prospect" means the adaptation of a room to the surrounding scenery; that of "aspect" may be taken as meaning the relationship of a room to the sun and the weather. A house may have a pleasant prospect, but if the aspect of the rooms is unsuitable in its position towards the cardinal and intervening points, the house will be anything but a pleasant dwelling. No one has given greater attention to this than Professor Kerr, and after a study of his valuable "aspect-compass," introduced in 1871, I have obtained the following general information. He once granted me permission to copy the diagram of his compass, and I cannot do better than reproduce it here, which may be of assistance to the reader. First with regard to aspect, it must be observed that the effect of aspect upon the interior of a room and upon the exterior of a room are two


Boisterous Winds
Cold Quarter
Cold Spring Winds
Night
Sunset
Sunrise
N
NW
NE
W
E
Sunset
Sunrise
Range of Sunshine for West
Range of Sunshine for East
Last Ray
First Ray
Range of Sunshine for South West
Range of Sunshine for South East
SW
SE
S
Hot Level Sun
Wet
Sunset
Quarter
Range of Sunshine for South
Range of Sunshine
Sunrise
Day
Longest Day
Medium Day
Shortest Day
Midsummer
Michaelmas and Lady Day
Christmas
Boisterous Winds
Sultry Quarter
Dry Quarter
Mild Winds

ASPECT-COMPASS.

different matters. Looking from a window in the north, the prospect or landscape will be lighted from behind. To the spectator looking from the south, it will never be so lighted; looking from the east, the landscape will be so lighted at sunset, and looking from the west, it will be well lighted throughout the day. The great thing is to reconcile both aspect and prospect in the choice of a house, but this can seldom be done, and where it cannot, the question of aspect must be first attended to, as being of importance to the rooms, and the question of prospect made secondary. The north is not suitable for a drawing-room, because the aspect is cold, and is more suitable for a dining-room, because during the winter the prospect cannot be seen as the windows are closed early. When the room used for morning meals looks also to the north, a bay window erected to the east will catch the early sunbeams, and render it a pleasant room. The northern aspect is too cold as a rule for bedrooms, but it nevertheless forms a suitable aspect for the servants' day departments, and is admirably suited for the larder and dairy. It is especially suited for staircases, as no blinds are requisite, and the passages can be maintained in a state of coolness.

The north-east aspect—next to the north one—is best for a dining-room, better for the servants' offices than even the north, and when an end window is wanted for a drawing-room, this forms no unpleasant aspect. Bedrooms which face north-east enjoy the morning sun, and during the summer range are agreeably cool at night. With regard to the east, this is also a good aspect for the dining-room, especially when no distinction is made between the dining-room and the breakfast-room, and with regard to a sitting-room the more eastward tendency it has the better. It is not adapted for a drawing-room, because in the afternoon there is an entire want of sunshine, and because of the unhealthy east winds. This point of the compass is suitable, however, for a library or business-room, because by the time breakfast is over the sun will fairly have warmed the interior of the room. It is also a good aspect for the porch, and one side of a conservatory should always face the east.

The south-east aspect is most suitable for the best rooms of a house, because it escapes the east winds and the scorching heat, and beating rains of the south. It is admirably adapted therefore for a drawing-room or day-room, is the most pleasant aspect for bedrooms, and is best suited for the nursery or for the rooms of an invalid. The south-west aspect is the least congenial of all, because it is so open to a sultry sun and blustering winds. This aspect should never be chosen for a dining-room, and in summer it is unpleasantly hot for bedrooms; and it is not suitable for a porch or entrance, on account of the driving rains which prevail during a portion of the year. The south aspect is not a very desirable one for the windows of a dining-room, and is unpleasant for a morning-room, unless a verandah has been provided; the larder and dairy should however never face the south. With respect to the west aspect, this is not quite agreeable for a dining-room, on account of the excessive heat prevailing in the summer afternoons. Neither is it desirable for the drawing-room, and should never preferably be chosen for bedrooms, although it is very agreeable for a smoking-room. One side of a conservatory should always face to the west. The north-west aspect is a very good one for a billiard-room, also for a dining-room, if the windows are fitted up with blinds to shade the sun.

Even after the site of the house has been carefully selected, and is deemed suitable in respect of its subsoil, its prospect pleasant, and the aspect of the rooms judiciously chosen, there are still remaining to be dealt with many matters which, if neglected, would seriously endanger the health of the inmates. First of all, it would be improper to erect even the most temporary dwelling upon a site from which the first spade depth of vegetable soil, with its contained roots and seeds, has not been carefully removed, because in such a case objectionable weeds will soon struggle through the chinks of the floor, and I have known cases where, when this precaution has not been taken, the vegetable growths have, after a time, lifted up portions of the stone flooring. No one would think of building a permanent residence upon a piece of ground without first removing the vegetable soil to some depth below the level of the floor, and no matter what the character of the soil may be, if it were wished to render the house perfectly healthy, he would, after draining the site—should this process be necessary—proceed to cover the whole of the superficies upon which the house is to stand with a layer of concrete, if only to provide against the evil effects of the "ground air" and its pulse-lowering influences. Sir Robert Rawlinson even recommends a layer of charcoal to be spread underneath this concrete.

In the country, fairly suitable sites can always be found for a house, but dwellers in towns and cities are not so fortunately placed; and of all the worst possible sites upon which a house can be built is that of an abandoned rubbish or dust-heap, with its hard or soft core, its animal and vegetable refuse, and other abominations. In a suburb not five miles distant from Charing Cross, I have seen a row of houses in course of erection upon "spoil banks" of this festering material, and I have seen the small amount of concrete which is used under speculative buildings of this kind actually thrown over a large dead animal, and in two or three days the walls were beginning to be raised above it. This must certainly be termed a very bad case, but very little less dangerous than hundreds of others in the neighbourhoods of large towns. Diseases, especially diphtheria, are almost certain to occur in houses built on such assorted strata, and it is a fortunate thing that such a thing is never permitted in the interior of towns and cities, where the population is densest.

Sometimes houses have been originally built upon a wet subsoil, and the rising damp, for want of a "damp-proof" course, as it is called, has been traced to the astonishing height of thirty feet, a height of ten feet not being at all unusual. Of course this capillary attraction is more observed in some kinds of stone and brick walls than in others. A similar source of dampness in houses is due to the building of the house walls close against the earth, without taking the precaution to build a blind area wall between the house wall and the earth excavation. Fig. 2A exhibits both of these important precautions. Here D represents the main wall of the house, and E the area wall, which is built against the excavated subsoil, leaving the space A between the two walls—the thick black line underneath the floor-joist representing the damp-proof course, which interposes between the subsoil G, with the foundations built upon it, and the main wall of the house. This damp-proof course usually consists of a layer of pitch or asphalte, or slates bedded in cement, or specially glazed tiles, known as Taylor's or Doulton's manufactures. By the use of this impervious course the upward passage of the ground-water is effectually arrested. The intervening area A it is also well to drain, but, as before explained, this water should never drain into the soil drain, if possible; certainly never so until it has been thoroughly disconnected. There should always, also, be a current of air introduced from the outer air, by way of ventilators placed at the top of the blind area A, and an air brick placed above or below the damp-proof course—preferably above—in order that the space between the ground and the joists or stone flooring of the basement may be thoroughly ventilated. This ventilation is shown by the arrows between C and C. Such air currents should always be provided under floors, whether there be a basement or not, and also always between the joists of the upper floors, and in the roof, in order to ward off dry-rot and ensure a constant circulation of air. In a country mansion in Lincolnshire, where a most disagreeable smell had been present for years, in a room no way contiguous to the lines of drains, I had the flooring removed, and found that the joists had simply

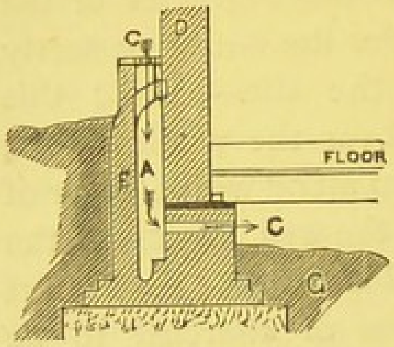


FIG. 2A.

been laid upon the ground, and were in the process of destruction by myriads of wood-boring worms. Those joists which these animals had already perforated, and in which they had died, were as light as a sponge, and after tying six lengths of them, representing originally six pieces of scantling some ten feet long, six inches by three inches in section, I was able to balance the whole of them on my extended palms, without the slightest difficulty. When there is no passage of air between joists in upper-room floors, other kinds of nuisances will occur, and I recollect a house in the West-end of London from which had been removed nearly a whole cartload of a foul-smelling fungus. This was due primarily to having made use of wet undesiccated timber, and if air gratings had been originally provided, the joists would, although unseasoned, never have been so enveloped.

Besides the before-mentioned nuisances resulting from want of ventilation, there is what is called dry-rot, which will speedily destroy the wood-work of a house ; but this subject need not be enlarged upon, as it is so well understood. Many times in the course of my practice have I had to underpin the walls of a house, and insert, just above ground, a damp-proof course, as well as build an area around the basement, in order to render the walls free from dampness, and no one except those who have had to pay for this could realise the trouble and the expense of the procedure.

CHAPTER II.

ARRANGEMENTS OF HOUSES.

ALL dwellings I would divide into six classes, at least for my present purpose. 1. Mansions divisible into ancestral seats, and large town residences. 2. High-class houses in the smaller squares and in the best streets, occupied by the upper classes. 3. Villas, large and small, detached and semi-detached. 4. Ordinary houses, occupied by the middle classes. 5. Small tenements in streets, inhabited by the working population; and 6. Cottages, such as those occupied by farm labourers.

It is not the design of this essay to enter into the many details bearing upon the construction of the above, but rather to point out generally, as far as space will permit, some points which particularly affect the health of the inmates. It would be impossible here to furnish examples of each class, and fortunately there is no necessity for it.

Illustrations of classes 1 and 3 abound in all Architectural Journals, and are given weekly in such papers as the *Architect*, *Builder*, and *Building News*, in London, and in similar publications in the larger cities. Class 6 will be dealt with elsewhere in the series. I have often deplored the lack of good publications dealing with this small, but most important class of dwellings, and at one time came to the conclusion that if the archives in the engineers' offices of the various railway companies were permitted to be ransacked for examples of small cottages erected at level crossings in this country, where there are gates to open and shut on their lines, an astounding amount of information might be gathered from the varying plans designed by scores of engineers, differing in their tastes.

The chief engineer of the Great Western Railway once gave me permission to make copies of all such cottages in the possession of his staff, but I could never find time to avail myself of his kindness.

In the following remarks I will make choice of those classes of dwellings, which offer the greatest facilities for explaining my meaning, when dealing with the general arrangements of a dwelling. The rest of the chapter might apply to any of the classes enumerated above.

It is greatly to be regretted that in London, especially, so very little care has been and is being taken to furnish commensurate air spaces, so as to satisfy the necessities of health. This want can be observed particularly in houses where ten, a dozen, or more servants have to move about in the basement in the daytime, and where some of them remain to sleep. Of course this state of matters is entirely due to the difficulty of obtaining sufficient room for a house where land is costly, and where many have to be housed, especially during the season. But these remarks as to want of air spaces are applicable to some other large towns. Most unfortunately, too, one can notice in country places small villas, so compacted in themselves as to necessitate the emplacement of sky-lights ; and still oftener, the only courtyard on the premises is covered over with glass, so as to simulate a conservatory.

With reference to air spaces, I will now give some examples of houses known to me in my practice.

Fig. 3 represents the basement of a house in the West-end of London, which covers some 650 superficial feet, independent of the vaults at A, and the front area at B. From front to back of the house proper, a distance of some 50 feet, there is no space open to the air, for all is covered over, and apparently was so from the time it was built. It may be regarded as a mere box, certainly not as a bijou residence.

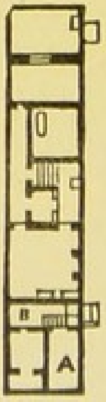


FIG. 3.

Fig. 4 exhibits the basement plan of a house in a West-end square, covering about a third more space than the foregoing example. When it was originally built, it fairly fulfilled the commandments as to light and space. For instance, there was the usual area space at A, a central yard at B; so that there was a fair circulation of air, and as much as an architect of the present day would deem sufficient. As time rolled on, however, the owner and resident desired to keep a footman, and a room had to be provided for him in the basement.

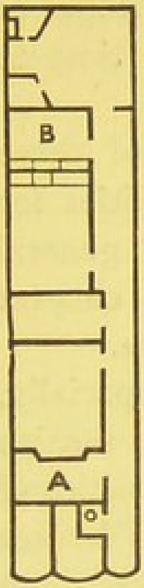


FIG 4.

In consequence of this the central yard at B, down the walls of which the soil-pipes and rain-water pipes ran, was covered over, and this left the whole of the basement without any open space whatsoever; and greatly to the detriment of the servants. This is a very common case indeed; but much worse than this was an instance where the owner, instead of forming a proper floor to an open yard which he took in, merely boarded over the old yard paving, and actually left the gulley in the centre of the yard, which had removed the surface water.

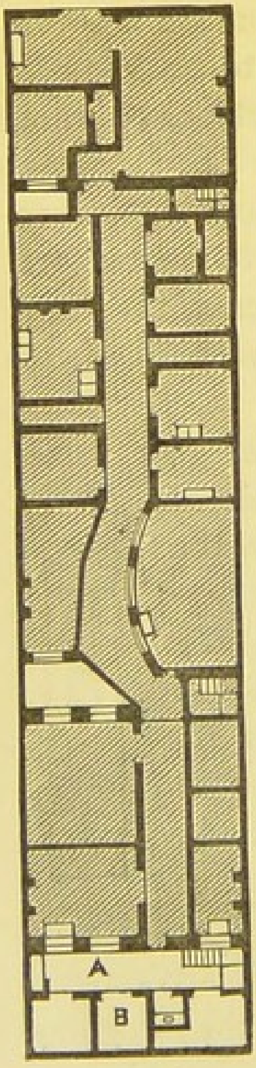


FIG. 5.

A very interesting example of the manner in which the basements of large houses are crowded out of almost every available open-air space, by one encroachment after another, is exhibited at Fig. 5, which represents the basement of a large town mansion, situated in a fashionable square. The space which is taken up by the residence, exclusive of the front area A, and the vaults B, is about 5800 superficial feet, and the open-air space, which is shown by the portions left unshaded on the plan—which is to a scale—is only a thirty-fifth of the whole.

By way of a contrast to the last-mentioned residence, as regards the air spaces or lungs for the basement, and as exemplifying what is reasonably expected in this particular by sanitary rule in such large mansions, I give at Fig. 6—which is to another scale—an example, but a different one, of a mansion in another square. The space covered by the residence, exclusive of the front area A, the vaults B, and the stable building at the back, which are engraved without cross lines, is curiously the same as the example given at Fig. 5, namely about 5800 superficial feet. Here, however, the open space equals one-tenth only of the house area.

It is beyond the scope of this work to enter upon any matters concerning the overcrowding of rooms; besides this is a subject appertaining to ventilation. I have simply given a few instances of overcrowding of spaces purchased for house-building purposes. The practice is still too common, and the professional adviser, I am afraid, falls too readily in with the desire of his client, to erect as large a structure upon his land as can be crammed into it.

Houses are also very faultily planned in respect to the position in that portion of the house interior which is usually appropriated to sinks and water-closets. In the basement, for instance, closets are often placed almost in the middle of the house, and the same mistake is committed on the floors above, a worse mistake by far; because then the closet would be placed on the landing of the stair opposite the best ground-floor, and chamber-floor rooms—the only ventilation from the closet-rooms being into the staircase, and consequently into the house.

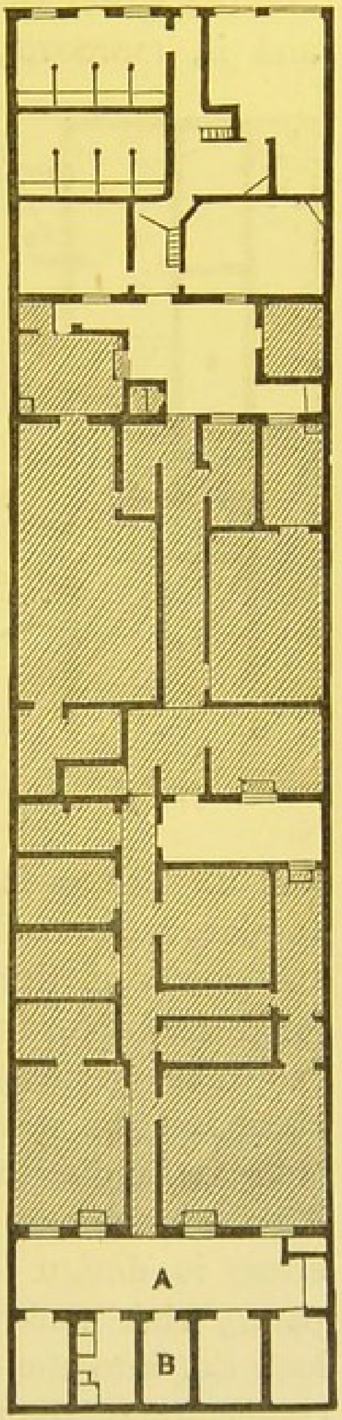


FIG. 6.

I will only give one example, and not from an old house either. It is given at Fig. 7. Here the basement closet used by the servants is placed at A, with an entry inside the house, and this closet has its seat placed alongside the passage wall, and is, moreover, between the larder B and the butler's pantry C. On the bedroom floors the closets are consequently on the landings opposite the bedroom doors. In the same room in which one of the closets is placed, there is a bath. It cannot be a wise thing to fix a water-closet—of even the very best pattern—alongside a bath in which a person may possibly stay as long as half an hour at a time.

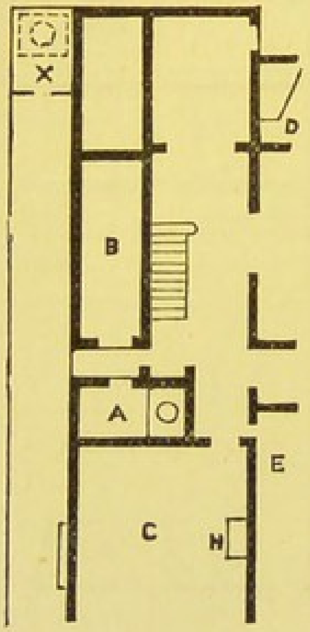


FIG. 7.

Here it would fortunately not be a difficult matter to move the basement closet from A and refix it at the end of the court-yard at X, away from the larder B, the butler's pantry C, the housekeeper's room D, and servants' hall E. But owing to the want of room upstairs in which to place a closet, the only thing which could be done with the closets on the bedroom floors would be to carry up a good-sized shaft from the closets up to above the ridge of the roof—properly protecting it from down-draughts—to close fast the window looking out of the closet into the staircase, and to fix a self-acting spring to the closet door. This is a simple example, but it exhibits some glaring errors in design. I may as well add that the butler's pantry sink could just as easily have been fixed so as to look out into the court-yard, and permit of a simple disconnection of the waste into the open air, as to have fixed it in the centre of the house at H.

It is very difficult indeed for architects to plan a house in a row of buildings with no garden behind. Fig. 8 exhibits the basement plan, copied by permission from a drawing for a London house, prepared by Mr. R. T

Blomfield, B.A., which was awarded a prize by the Royal Academy of Arts last year. In point of space in the block the allowance is liberal. The site covered by the house—not taking in the front area A, fresh-meat larder B, or coal vault C—amounts to 1875 superficial feet in all, and of this over one-twelfth is an open space between the servants' hall D and the kitchen, with windows looking into it from all sides. The servants' closet is not placed here in an area vault, as is commonly the case, but against the end wall, beyond the open court-yard, and the closet-room is ventilated by a shaft above to the outer air. This closet is 23 feet distant from the main wall of the house, which rises to a fourth story, and this is much better than placing the closet in the front area vault at B. The architect has made the most of his space.

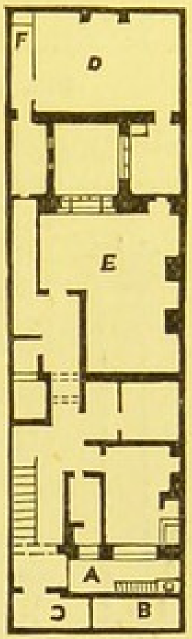


FIG. 8.

It is unnecessary for me to deal with the ventilation of the house, as regards the inlets or outlets of air, the measurements of rooms, the sufficiency of light, or the systems of heating the house, because these will be treated in other handbooks by the best authorities. I would only wish to add to what I have before stated, that to the close, cramped spaces to which water-closets are relegated, with their utter want of ventilation, is due many of those ailments which assail a household, the children especially. Housemaids' sinks are also too often placed in dark cupboard-like spaces, where it is impossible to detect dust, dirt, or objectionable matter unless with the aid of a candle. In newly built houses similar monstrosities will also be discovered. And to make matters worse, the staircases are often badly designed, and in no way act as a ventilating medium.

Although the broad subject of ventilation will be treated of in a separate handbook, it is, nevertheless, requisite in this work to offer a few remarks relating to the simple forms of "inlets" and "outlets," which I feel it necessary to mention, taking into consideration the title of this work.

The inlet of fresh air into a house can be secured in many ways. Supposing the room to be a larder or a dairy, and not a living room, nothing could be better than making use of the simple sliding air brick such as is drawn at Fig. 9, and placing several of them below the skirting, and below the ceiling line, so that there should be an interchange of air.

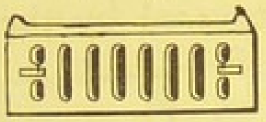


FIG. 9.

In living rooms and bedrooms, probably the best contrivance to make use of is what is known as Tobin's tube, with its lower extremity in connection with an opening through the wall, the amount of inflowing air being controlled by the valve A, shown at Fig. 10, situated near the top of such a tube. The one figured is suited to the corner of a room, but they can be made of any shape. This method of procuring a constant introduction of air into a room does not create any tendency to draughts, because the air is impelled above the head, towards the ceiling, and then diffuses itself through the room.

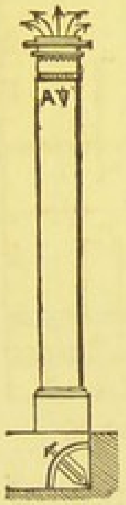


FIG. 10.

A simple economical and automatic inlet ventilator is at the hand of every one whose house is furnished with the ordinary sash windows. I allude to the device shown at Fig. 11, the merit for which has been claimed by various persons, but was first published by Dr. Hinckes Bird. All that is necessary is to raise the lower sash of the window, and place in the inside of the room, so as to close the opening made by the raised bottom rail, a piece of wood of a corresponding depth. If the bottom sash be lifted three inches, an inlet of air of this depth will be established between the meeting rails in the middle of the window, and will yield an agreeable volume of fresh air without perceptible draught. All bedrooms should be constantly ventilated in some such way. So valuable to health is the fresh air, thus admitted by way of the window, that many devices have been patented to

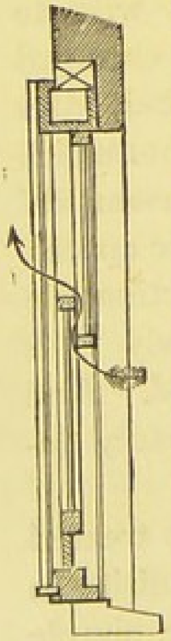


FIG. 11.

produce the same effect, by more or less pretentious but unnecessary adjuncts.

The above systems of "inlets" are for use alike in town or country, but when the upright tube form of ventilation, shown at Fig. 10, is adopted in a manufacturing town, or where there is much consumption of fuel, with a corresponding non-consumption of smoke, the blacks and smuts would very soon speckle the table-cloth or counterpane; and, in order to avoid this, one London firm introduces into the tube a filter bag of gauze. The most effectual method of cleansing the incoming air, without arresting its flow, or checking its current too much, is to place, at the bottom of the vertical tube, inside the room, a box divided with deflecting plates, by which the in-passing air is directed downwards on a trough of water. This contrivance is shown at Fig. 12, and it can be easily imagined that by pulling out the tray containing the water, disinfectants can be placed there, or, for the matter of that, ice to cool the air during the sultry months.

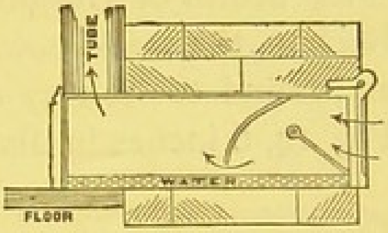


FIG. 12.

In regard to "outlets," and without going into anything approaching a history of them, it will be sufficient here to say that the simplest and best form of outlet is that of the Arnott type, which is fixed in the flue of the chimney belonging to the room, as near the ceiling line as possible. There are various kinds of outlet ventilators for emplacement in the flues, and where a slight flapping noise during high winds would not be an objection, the Boyle's mica valve, shown at Fig. 13, would be found valuable.

A view of the working valves of this useful outlet is given at *a*, but all that would appear in the room would be an oblong plate flush with the wall, as shown at *b*. Very good outlet ventilators of this description are those of Kite, Crosley, and others.

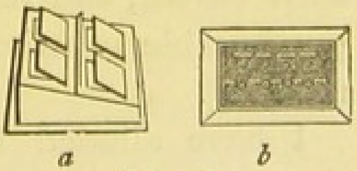


FIG. 13.

In town houses taken for a short time, the incoming tenant is very often admonished never to interfere with the rooms of a house in the way of fixing any new contrivance which would disfigure the room, and, most of all, he is warned not to place a ventilator in the flue. It often happens that the tenant has taken a house which is very deficient in ventilation, and most unbearable in the rooms which ought to be the best ventilated, and, as his health would positively suffer, he must somehow without transgressing provide for the removal of the respired air and products of combustion. He can easily do this by making use of the contrivance first given to the public by Councillor Smith of Glasgow, experimented upon by Mr. W. P. Buchan, the well-known sanitary engineer of the same city, and found to be very effective. A zinc pipe, marked D in Fig. 14, 6 inches in diameter, is taken from a point 5 inches below the ceiling, and brought down to within 15 inches of the floor level, bent at C, and led within the upcast influence of the fireplace A. Such a tube will certainly not look very presentable in appearance; but then it would only be a temporary construction, movable at the end of the tenancy, and when erected the hot air at the top of the room would be sucked down the tube from its mouth E, and escape up the flue B, rendering the room more habitable when a fire is necessary and the gas is burning. Speaking of gas, unquestionably it is wise to remove the products of combustion by a tube fixed above each burner, and leading into an upcast shaft, and several purchasable contrivances of this kind are already in the market.

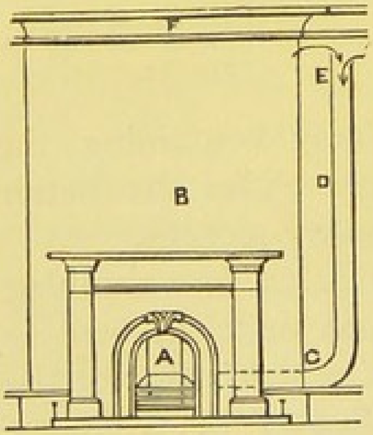


FIG. 14.

I have alluded to the possible necessity for disinfection, and stated how it can be achieved in a very simple way, by allowing the air to pass over a disinfecting material placed in an inlet apparatus. It does not form part of my subject to deal with disinfectants, but I must nevertheless mention that I think that all very large establishments, especially in the country, should be furnished with some means by which anything can be purified. In towns the disinfecting apparatus of the parish is always at command, but in the country it is different, and generally a bath of the fumes arising from burning sulphur is resorted to. In most large country houses there is to be found a lighting gas-generating apparatus, in which case it is very easy to provide a suitable disinfecting medium—such as for instance, that of Mr. T. Jennings of Lambeth, in the chamber of which, within twenty minutes, a heat of over 275° Fahrenheit can be generated, which may be taken as the highest degree of heat required in an ordinary way. The apparatus is constructed in such a manner as to prevent the burning of articles placed therein, and requires very little attention. Mattresses, woollen, and other materials, are cleansed and rendered elastic in a short time, and the heat penetrates everywhere.

ESCAPES OF SMOKE AND GAS IN HOUSES.

There are several matters bearing directly upon the health and comfort of a household which are attributable neither to the arrangement of the dwelling, the want of pure air, nor to deficient drainage. I allude to the smell due to escape of spent smoke from faulty flues, and to that from leakages in gas-pipes. Both simulate a drain smell at times, and are frequently taken for it.

The lesser evil of the two is that due to the escape of smoke into a room, not by way of ordinary back draughts down the chimney, but to the smoke which passes into the room by way of cracks in the flues, generally between the chimney mantel-shelf and the ceiling. This erratic smoke is due to the perishing of what is termed the parging of the flues, which "parge" is an admixture of mortar and cow's ordure, the material exactly suitable for plastering the inside of a flue, inasmuch as whilst it may flare with the heat, it does not readily break into sections and leave the wall. In time, however, the parge does perish and fall away, and there is then nothing between the interior wall surface of a room and the smoke-shaft but the mortar in the joints of the intervening brickwork. The heat, which passes up the flue in due time, causes this mortar to pulverise, and then the smoke with its noxious auxiliaries soon find their way into the room. When the escape of spent or other smoke into a room is suspected, the plastering of the wall should be laid bare, and if there be really an escape, the lines of exodus will be easily discoverable on the wall, in the shape of long dark lines stretching across the flues.

Escapes of smoke into rooms by way of a perished flue are often cured, for a long time at least, by cementing up the cracks where the mortar has fallen away ; and to effect this, a handy sweep who can use a trowel is sent up the flue with the light and the proper materials, the distance of his ascent being made known by knocks against the wall. Sometimes, however, this cannot be resorted to on account of the smallness of the flues, and in such cases nothing remains but laying open the flue, and either effectually closing up the interstices and re-parging, or building in proper earthenware flue-pipes, and grouting around them with concrete. The best architects now always make use of these pipe-flues, and obviate all chances of any smoke escaping into the rooms. When once smoke penetrates into a room, immediate steps should be taken to remedy matters, as the evil increases with immense strides, and becomes more costly to remedy every year. I can point out a mansion in the West-end of London built during a strike of the workmen, and possibly by ignorant tradesmen, where every one of the flues had to be cut open last year, and flue-pipes inserted at a cost of over £300. The same thing constantly occurs in the country, and I know a rectory in Hampshire where the gable walls had to be taken down and new flues constructed. The smell from the faulty flues, owing to the quantity of wood burnt, was so repulsive, that the best rooms were next to uninhabitable. Thirty pounds sterling had also been spent upon the drains before the true cause of the nuisance was hit upon.

The nausea which results from escaped smoke is not, however, to be ranked in importance with the dangers which accrue from the escape into rooms of illuminating gas. With this agent come terrors of a worse description, in the form of explosions and asphyxia, of burnings and of suffocations. Medical journals furnish woeful cases of whole families who have fallen victims to inhaling air heavily laden with gas, and the public papers furnish from time to time terrible results due to explosions.

I have several times explained how very necessary it is that when gas has been laid on to a house, and the company's main connected to the meter, or even before the latter has been done, that it is extremely important to have all the gas-pipes tested, in order to ascertain whether any leakage exists. The method which I employ when I find it necessary to test the gas-pipes is as follows: All the brackets and pendants, with one exception, are first of all stopped up with plugs or screwed caps, and the meter turned off or disconnected. Upon the one outlet not stopped up a force-pump is attached, into the interstices of which there has been poured a few drops of sulphuric ether. The force-pump is then connected with a gauge, and is worked until a high pressure has been registered upon it, in order that should the pipes have any latent weaknesses, seams just ready to open, or pin-holes filled with grease which might not drop out for years, the pressure exerted would tend to rip open the one, and cause the other to fall out. When the gauge indicates a certain figure the pumping is stopped, and if the mercury is noticed to fall, it is evident that there are palpable leaks which are at once searched for. The escaped ether will guide the operator to the whereabouts of these leaks, and the defaulting pipes are at once replaced by others. The pumping is then continued, and the same routine recommences. If the mercury still descends in the gauge glass, and the sense of smell cannot detect where the leak exists, the joints and portions of the pipes are lathered over with soap, whereupon the weak places will be found indicated by bubbles. These parts where the bubbles escape are then marked, heated by means of a portable spirit lamp made for the purpose, and covered over with an approved durable cement. After a short time the pump is once more set in action, and if the pipes are tight, and the column of mercury in the gauge maintains itself at the same figure, the soundness of the pipes may be taken for granted.

There are several methods of testing gas-pipes, but this is the most effectual. Some system of house-pipe testing should really prevail with us as it does in America, where every gas-supply laid on to a house is tested and approved by the inspector before he will sign the order requisite to attach the house-pipes to the gas-main. Many of our gas workers apparently do not see the necessity of taking especial care when dealing with gas. Often, too, the man sent to fit up the gas is a blacksmith, a whitesmith, glazier, brazier, plumber, bell-hanger, and gas-fitter, all rolled into one.

CHAPTER III.

HOUSE DRAINING.

JUST as a look at the sun is associated with its accidental colour—violet—so is the word "house" associated in a concrete manner with the idea of "drains." As there is a great deal to be said regarding the latter, I will make use of no further space, by way of exordium.

The drains of houses must be classified according to the material of which they are composed, and I would divide them into four classes: 1. Brick drains; 2. Earthenware-pipe drains; 3. Cast-iron drains; and 4. Other proposed drains. It is with the three first divisions that I shall deal, discarding the last as being too fanciful, which will readily be conceded when I mention that glass is mentioned as a suitable medium for removing the underground drainage.

BRICK DRAINS.

Brick drains are variously shaped, the worst sections being those upon which two upright sides of brick have been built upon flat stones, so as to form a bottom, and then covered over with other flat stones. This is the very worst pattern of drains in which brick forms any portion, because the bricks can never joint tightly with the stone, and there is, therefore, always a leakage going on into the surrounding subsoil. For my purpose it will be sufficient merely to remark, that the other sub-class of brick drains consists of those which are constructed of bricks throughout, and may take either a circular or an egg-formed shape—the last one being the more modern of all brick drains.

One great objection to brick drains is due to the fact, that they cannot be constructed sufficiently small to meet the requirements of a house, and that consequently brick drains are seldom found less than nine inches in diameter, which is far too large a sectional area to properly drain a house. This mistake of providing drains too huge in diameter for the work which they are required to do obtains all over the country, in old houses, where brick drains were used, and it is not an uncommon thing to open up drains in the basement of a house, and discover them to be eighteen or twenty inches in diameter, and even more, when a pipe six inches in diameter would have been sufficient. London is an especial delinquent in respect of these old brick drains, and the generality of the houses which were built before the last fifty years will be found equipped with these huge and unmanageable brick drains.

However compactly and well-burnt the clay has been made into bricks, a brick drain has only a certain life, so to speak, before its decadence begins with the usual attendant danger. Its lifetime, of course, is longer or shorter according to the subsoil in which it is placed, the material used as mortar, the gradient at which it is laid, the sewage which it removes, and the quantity of water, and especially of heated water, which passes through it. But without going into any details of the causes of deterioration of the brick drains, we will assume that the concensus of opinion in their disfavour for use in the interior of a house is overwhelming, and that a universal preference is accorded to drains formed of earthenware pipes. The great objection to brick drains, however well they may have been built, is due to the want of smoothness, especially at the bottom, whereby the effete matters are not carried easily away, and, when it is considered that this want of smoothness is aggravated by the added roughness due to the unequal perishing of the bricks, no one would approve of brick drains, and repudiate the use of well-laid glazed earthenware-pipe drains, with their smooth interiors. Nevertheless, despite all that can be said against brick drains—and they have been of great service to the community—in anathematising them, we must bear in mind that they were used previous to the advent of water-closets, and that the removal of soil was not forced upon them. Moreover, those who had the conduct of laying down house drains, even after the institution of the water-closet, wisely preferred employing their more skilled men in building brick drains, rather than in making use of the non-socketed and unglazed earthenware pipe, which was even at that time very well known, but was not manufactured of sufficient diameter to suit their exaggerated notions of necessity.

One of the first proofs of the perishing of a brick drain, making it past redemption, is well diagnosed with the first appearance of rats. I must not be taken for saying that the flesh of these little rodents is not, as an article of diet, all that has been asserted in point of delicacy by the well-known rat-eating society in Belgium, or by a certain reverend English gentleman. All that I would say is this, that an underground drain is not a place for rats to breed in, and that it is an unpleasant matter to meet them upstairs and downstairs and in my lady's chamber.

The mediæval Arab writer, Ebi-Bacthar, declared that eating rats' flesh produced great intellectual weakness, and I should assume the same lamentable result to have occurred were I to meet a householder in town or country who would regard an invasion of rats into his premises with equanimity. Rats go, and always will go, to that place which affords them most food, and it is the brick barrel drain which receives the washings from meat plates, and the grease from the scullery pots, which rats most commonly frequent. During the present year, I have known them to leave the sewer and clamber between walls of a country house, and scamper up partitions until they have lodged in the roof, whence they issued to attack the bacon stores in the attic. They will leave a drain, and nest themselves in the thatched roof of a farmhouse, and they will form whole villages under the floors of a town house. When busy exploring underneath the rooms of a house in the S.W. district, built, I should say, some eighty or ninety years ago, with a view of accounting for the prevalent smells, and whence the rats made their sally-ports, I discovered a perfect colony of these animals with their families, and on removing the nests, we found between joists and sleeper-walls, some half-dozen silver spoons and two or three pairs of candle snuffers. Over 450 rats were killed by the men and their dogs, or shot down during that raid, after once the house was cut off from the old sewer in the road. I took down next morning a favourite mouser, but the remaining undiscovered rats worried and killed the cat during the following night.

Rats generally find their way into houses by means of holes which have been formed in brick drains by the falling down of perished bricks from the arch, or owing to their having contrived to make a passage through the brick drain above the usual wetted perimeter. These rats, in the case of country houses, may come from the stables, the barns, or the brooks; but in town houses they chiefly emanate from the sewer, but no matter whence originally derived, they soon become habituated to a house and its dainty scraps, and having once engineered their way thither, are seldom effectually dislodged, especially in country residences. As fast as a hole is discovered and stopped up, another is made by these persistent vermin, until the foul air evolved from the house drain becomes so distressful, and the rats so multiply, that some further steps are necessary in dealing with them. For instance, the professional rat-catcher is sent for, with his ferrets of the pole-cat breed, and the rats are driven out and destroyed. Occasionally they are driven into a *cul-de-sac*, when they should be removed from the drain after these blood-sucking animals have pinned them across the neck. In old country houses, the rat-catcher always works from the roof downwards, and destroys them at the places where he has posted his dogs and ferrets.

It is seldom that rats in towns reach above the basement, because above, there are no pantries, or larders, or cheese-rooms, or bacon stores, or meal bins, and the custom of rat-catchers in town is to fix a close wire net, with a self-closing door at the flap-trap in the sewer, and drive the animals into it. In other cases, where the evil has not yet grown formidable, traps are made use of, or poison; but this last is a dangerous resource, as the rats are apt to die underground and emit during decomposition, which lasts for months, the most horrible smells. I knew a country house where rat poison had been largely used, and the expense of finding out the whereabouts of the rats which had escaped from the drains in order to seek a place to recover in or die—and they generally run towards fire-places—cost the owner of the house, plus the laying down of a new pipe drain in place of the brick drain, some hundred pounds sterling.

Before leaving the question of rats, it might be added that they are remarkably clean animals, and will never allow their fur to come in contact with anything that cannot easily be immediately cleaned from it, hence, very often a dairy, larder, or granary is surrounded by a trench outside the brick walling to a certain depth, by broken glass and gravel, well grouted with tar. Let no one rely upon a syphon trap in the drain, as a means of keeping out these voracious and fastly breeding animals, for I have seen them diving through the trapping water to reach the other side of the syphon. The flap-trap at the junction of the house drains with the town or city sewer, offer still more advantages to the invading rats, because it is seldom shut close enough to prevent a rat opening it, and when it once gets into the house drain, it will speedily, where there is an open joint, even if the pipes be of earthenware, find its way under the floors, make its nests, and harass the occupants.

To show how rats will eat even through lead pipes an eighth of an inch in thickness, see cut from a photograph of a pipe in my possession, at Fig. 15.

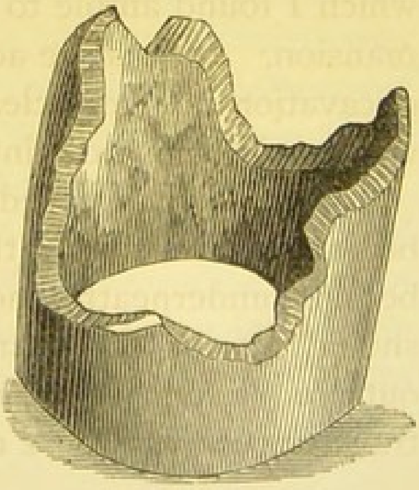


FIG. 15.

In the foregoing remarks those brick drains have only been referred to which are commonly found under ordinary town and country houses. Under country mansions, such as I have had to deal with in most counties, it is common enough to find house drains where an adult could walk upright underground, or with but a very slight stoop. These are the most dangerous brick drains of all, because they contain so much gas, are often in connection with large cesspools, and are remorselessly trapped against any possible dilution by respirable air from outside. Some few years ago I had occasion to explore such huge drains underneath a patrician house in a western county, and I foolishly did so one summer's morning before breakfast, the consequence of which was that I was confined to my house for three months, owing to blood poisoning. To this Class 1, of huge drains, formed by bricks, may be included those very large drains which have been excavated under a house or tunnelled under it, owing to the ease which the stratum of stone upon which the house was built offered for the formation of a drain, which did not require building up. These old-fashioned drains are not very commonly met with, but I shall never forget making a section of one, some 65 inches high and 30 inches wide, and drawing a section of the 9-inch pipe at the bottom, which I found ample to act as a *cloaca* to that half of the mansion. It must be admitted that this old red sandstone excavation was very clear from deposit, but the declination was ample, and the rainfall always scoured it.

I have badly succeeded in explaining myself, unless it be gathered therefrom that brick drains should never now be built underneath a house, that where they so exist they should be suspected and removed, and made use of for outside sewers only, which proper inspectors regularly traverse seeking where repairs are necessary.

PIPE DRAINS.

Having shown the necessity for discarding brick drains underneath a house, it will be necessary to consider alternative clay-derived materials, and these are set forth in Class 2, alluded to in this chapter. I mean pipes formed of baked clay, after the latter has been worked to a consistency which would not naturally allow of an escape of their contents. There are, however, two or three subdivisions of this class. First of all come those kinds of pipe drains of various sizes—I do not speak of rudely made agricultural tiles for draining land—which followed the discardment of the old brick drain. These pipes were made of various sizes, but the ends of them merely abutted together, and were not, as at the present day, socketed at the joints. They were made of very suitable clay, and fairly resisted warping, but owing to their more or less porous nature, and the impossibility of rendering them sufficiently watertight at the joints, they could not have proved very successful. I only mention them because they are very frequently found in country houses, and when these houses are sold, credit is taken in the catalogue for "pipe" drains which remove all the wastes of the house. They are certainly pipe drains, but pipe drains of a regrettable pattern, which have allowed their exterior to be surrounded with infected subsoil and ooze. These drains are therefore almost equally faulty with brick drains, because when once they are poisoned and become the habitat of life-destroying germs, their normal tone cannot possibly be recovered.

The only kind of earthenware drains which ought to be laid down inside a house are glazed socketed pipes, well formed, well kilned, and properly laid down, the whole of the pipes having been laid on a concrete bed, and afterwards covered over with properly made concrete, so as to prevent any possibility of sewage reaching the subsoil, and especially water-tanks. It is not every glazed socketed drain-pipe that is fit for laying down, for the most abominably shaped pipes are often met with. I give, at Fig. 16, a cut from the photograph of a pipe in my possession, which exhibits, beyond anything I have ever seen, the careless manner in which some makers send out goods, in the manufacture of which excessive care is a necessity. There are happily, in many parts of the country, makers of drain pipes for houses who are beyond reproach, and have received medals for the good quality of these productions, and there are scores of pipes showing patent methods of jointing, more or less complicated, to be met with in the sanitary market. But however interesting to an architect or engineer, their history would prove tedious to an outsider. The majority of these improvements refer to the fast seating of the ends of the pipes in cradles, well covered in cement, and one especial patent much in use, that of Mr. Stanford, provides against all chance of pipes being sent out with such joints as that shown at Fig. 16, by forming—upon of course a proper pipe—a ring of material fitting truly upon a ring of similar material in the socket of the pipe, so that when the two ends are put together, with a little grease or resin between them, the pipes fix closely together in every direction, and require but little other luting. These kinds of pipes are generally adopted for use under a house, and the the ordinary socketed pipe for use outside. In conclusion, it may be said that any sound form of glazed socketed earthenware pipe can be made to properly fulfil the requirements of health, provided that it be duly laid, well jointed, and surrounded by concrete.

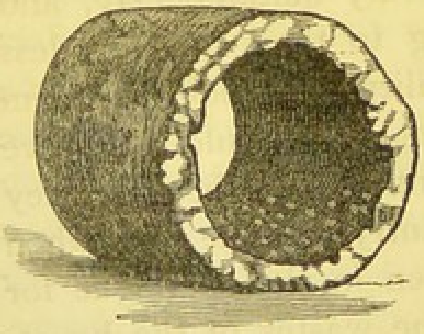


FIG. 16.

IRON DRAINS.

Drains of cast-iron material are now very often used in place of earthenware pipes, and there is a great deal to be said in their favour, especially since the invention of several processes whereby the interior is prevented from rusting and scaling. The idea of making use of iron pipes is not a new one, because I have taken out of a house in Piccadilly, London, iron drain pipes which had been laid down over fifty years ago, and the condition of which, owing to the amount of rusty scaling in the interior, and the perishing of the joints rendered the drain no longer serviceable. The inventions of late for the protection of these pipes, such as by galvanising them, by coating them inside with Dr. Angus Smith's solution, or by treating them on the Bower-Barff system with super-heated steam, have rendered them far more reliable than formerly as a conduit for sewage. Pipes of this material are useful underground in rows of houses, and wherever straight lines of delivery are obtainable, and compared with drain pipes of earthenware, with their necessary surrounding of concrete, they would prove not more expensive. In a large house in London, I have laid iron drain pipes throughout the basement, above ground, along the walls, whereby the slightest escape of gas or sewage could be easily detected, and I am inclined to think this is the best method of draining a house. Unfortunately, however, this system cannot always be adopted, unless the house has been planned with a view to this method of drainage; and in most houses it will be observed that the pipes would have to run in front of fireplaces and across doorways if pipes above ground were made use of. When iron piping is used, great care should be taken with the jointing, to see that it is properly packed, and with material calculated to last as long as the pipe itself. Iron pipes with merely leaded joints are subject to galvanic action, whereby the iron, sooner or later, thins out by corrosion, the iron perishing by "abnormal local oxidation," as has been very forcibly stated by Mr. B. H. Thwaite. When iron is contiguous with lead a galvanic action is set up, and, the latter being electro-negatived to the iron, the iron suffers. There ought, therefore, always to be an assistant packing in the pipe, and the majority of engineers make use of this. I would also advise, in addition, a luting of Portland cement with the other materials, which may include a previous stuffing of fibrous packing material together with the old-fashioned iron filings and acids.

Given the best kind of drain to lay down, there is still the question as to where to lay it, and here lamentable errors are frequently made. The chief fault perpetrated in this particular is the laying of drains inside a house, when they might just as easily have been laid outside the house. An instance of this stupid mode of draining a building is exhibited at Fig. 17, which shows the basement floor of a residence which I have just re-drained. One would scarcely believe that any one would take the drains through the house, as shown by the continuous line on the plan—and, in fact, direct the whole of the wastes of the household to be drained through the house—when they might just as easily, and with far more propriety, have been laid down entirely outside, on the course shown by the dotted lines, which indicate the route adopted by me.

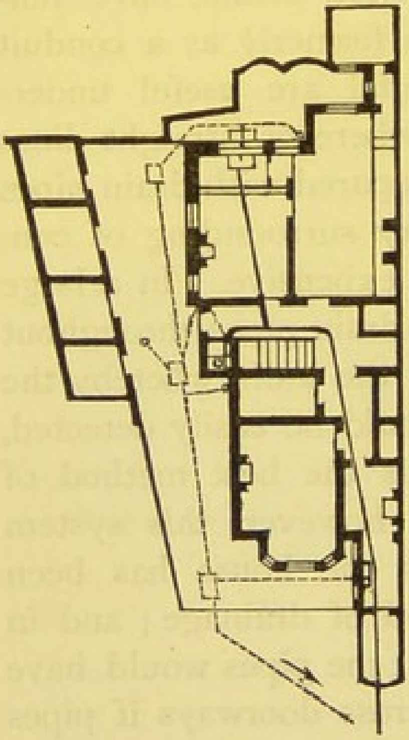


FIG. 17.

Examples of this careless system of laying down drains inside are common in the experience of all architects and engineers who have to deal with house drains, but I cannot enlarge further on the undesirability of drains being laid inside a house, when with the greatest facility they might have been taken outside. Indeed, their portfolios are more or less filled with instances of the kind, and one peculiar example I borrow from Mr. Wallace Peggs, C.E., as having occurred in his practice. This example is shown at Fig. 18, where badly laid 9-inch drains, half filled with sewage, followed the lines shown on the plan, the lines of drain being inside the house, when they might have been more properly taken in an open passage outside the house. The man-holes A and B were evidently built in order to be able to clean out the objectionable drains. There were, moreover, the usual accompanying faults of cisterns and sinks running direct into the drain, and when the upper closets were used the sewage in the badly laid drains was violently agitated, and a continual oscillation was going on for a time in the drains through the kitchen C, thereby furnishing volumes of sewer gas into the interior of the house. The soil-pipe was also inside the house, with bad ventilating continuations, and with no disconnection of the house drain from the sewer.

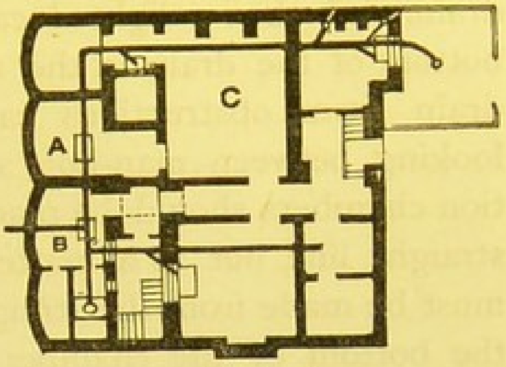


FIG. 18.

In laying down house drains there are several rules which should be followed, and without going into this matter in elaborate detail, or endeavouring to make this handbook take the form of a merely technical treatise, there are nevertheless sundry maxims with which every one should be acquainted, when house drains are in question.

Whenever a drain is laid down, nowadays, care is exercised in order to get the pipes as much as possible in straight lines, and at each departure from a straight line a man-hole is formed, enabling any one to inspect the condition of the drain at any moment of time, by merely lifting up the man-hole cover. At Fig. 17, already alluded to, it will be noticed that the continuous straight line, representing the old drain inside the house, has curves in its progress, and was not provided with any assistance for inspection, whereby its choked condition could have been ascertained. The proper treatment of the drain is exhibited by the dotted lines outside the house, and it will be seen that there are three inspection chambers on the way to the sewer. The object of these inspection chambers is to afford a ready method of testing the condition of the drain, and when a lighted candle has been placed at the bottom of the drain in the man-holes, the freedom of the drain from obstructions can be ascertained by simply looking between man-hole and man-hole. These inspection chambers should be placed at every departure from a straight line, but as a matter of course, when a deviation must be made from the straight line, the half-open pipe at the bottom of the chamber can be curved, and suitable curves are sold by most manufacturers made of enamelled earthenware. It is found always best to build these inspection chambers where several drains junction together, and at Fig. 17, the centre inspection man-hole had to receive the soil from the upstairs closet, the soil from the servants' closet, the bath water from an open gulley, which received it, the rain-water from the roof, the surface water of the yard—and all these into the main line of the drain, which passed through the man-hole. A view of this particular man-hole is given at Fig. 19, and it will be seen that each drain-delivery is open to sight, and that rods could easily be introduced up the drain pipe should any obstruction occur. These inspection chambers are always best protected by an iron man-hole cover, such as that shown in the sketch, and these covers can be obtained fitting down so perfectly into their iron frames, which have been sunk into the stone floor, as to be absolutely air-tight. There are many patterns of these air-tight covers, and one might mention those of Mr. Angell, of 144 Fulham Road, and Mr. F. Dyer, of Camden Town, in London.

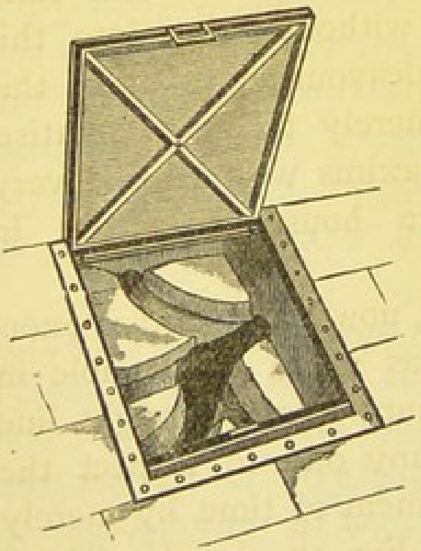


FIG. 19.

By the use of "rods" just alluded to, is meant the introduction into a drain of lengths of cane or bamboo, about two feet in length each, which are easily attached to each other, and when fitted at the end with a scraper or brush, can be made to explore a drain, even 100 feet long, and easily from man-hole to man-hole. These rods are almost identical in form and method of jointing with the rods, having screw attachments, used by sweeps for cleansing flues. The best rods, however, it is said, are those which do not rely upon a screw, but upon a simple catch joint, the same as those used by the Lincoln Authorities, made by Messrs. Read & Co., of Aberdeen. Every country house should be equipped with a set of rods of some kind or other.

When a householder encounters inside a house an old brick drain, which it is necessary to remove—and all brick drains should be removed—he should insist upon the workmen carting away every vestige of the old drain, every brick and every portion of the subsoil, which indicates its having been fouled by escaping sewage. It is far too customary to remove only the upper portion of the brick drain, and leave the lower portion untouched, laying the new pipes on its bed, without disposing of the old brickwork below with its possible surrounding of foul subsoil. It will generally be discovered that brick drains have been originally laid down with an insufficient declination towards the outfall, and that by taking them up throughout, a much better fall can be obtained for the re-placing pipe drains.

HOUSE DRAIN DELIVERIES.

House drains in the country have several kinds of outfalls, by which term is meant the system of final delivery of the sewage at the end of the drain. In the country the modes of outfall deliveries may be divided into (1) cesspools; (2) open ditches, streams, or ponds; and (3) sewage irrigation lands. In towns and cities the deliveries are into (4) sewers leading to the sea, river, or irrigation beds. Both in town and country alike another method obtains, viz. (5) that of the dry system. This last-mentioned method of dealing with excreta will, however, be treated elsewhere.

I must say a few words concerning cesspools in the country. These may be divided into several classes. The first kind are those which are simply excavated in the rock, and which are not intended to hold water, and where the liquids escape from the cesspool, owing to the porosity of the material, or by the fissures of the rock. Cesspools of this description are very common, especially in the chalk districts, and I have come across scores of instances in country houses where the cesspools, having been excavated in the chalk, have received the drainage of the house for many years, and upon opening them no liquid was found, and scarcely any remains of solids. On one occasion in Berkshire I discovered a cesspool close upon 90 feet in depth, which was covered over and unventilated, and the entry of the house drain from the basement floor into the cesspool was 17 feet below the surface of the ground. This was also in a chalk formation, and was the first I had discovered holding water, but I speedily discovered, as the reader will have surmised, that this cesspool, which was close to the house, had been a well, which had been disused owing to its supplying tainted water. Curiously enough, when once a chalk cesspool has been emptied, and the bottom or sides of it scraped out, it will retain liquid sewage always afterwards. This kind of cesspool is very dangerous, as the escaping foul liquids travel in the fissures of the rock, and I have traced the escaping wastes from a house cesspool to a well, some 300 feet distant, and noticed how they trickled down the sides of the well several yards below the surface of the ground.

Cesspools which may be classed with those just alluded to, are those which are not built inside with material, so as to render them impervious and water-holding, but are simply built with dry walling without cement. The object of making use of cesspools of both kinds, is to escape the necessity of pumping the cesspool out. Such cesspools should be abolished wherever they exist.

Another kind of cesspool is that which is built of brickwork and rendered over inside with cement so that its contents can be retained, and pumped out if necessary, and which has an overflow leading to some place of disposal The solids remain at the bottom of the cesspool and speedily fill up. Cesspools even of this description are by no means commendable, even when ventilating pipes have been led from them, and the only excuse for employing them at all is the wish expressed to make use of their contents as manure. In point of fact, however, the cesspool is seldom emptied for this purpose, or until its neighbourhood is tainted with the contained foul material, and its overflow positively blocked up by the thickening crust at the level of the outgo. The cesspools are also apt to be in direct communication with the house by means of the house drain, owing to the want of a proper disconnection between the drain and the cesspool. It is here where nearly all the mischief connected with water-holding cesspools is to be traced, and the method of disconnection recommended in cases where cesspools might be permitted to remain under certain special circumstances will be described under the head of "Disconnection of Drains." Very often when a house is being examined in order to account for its unhealthiness, the house drains will be found in communication with cesspools, the presence of which have never been suspected, and which have not been opened up for half a century. I have frequently discovered such in the grounds around a house, and have found them to communicate with the house by drains which have been in long disuse, but nevertheless communicating their evil influences to various parts of the residence by way of long-forgotten waste pipes.

Some most extraordinary cases I could quote from my note-books of country houses which were formerly drained into cesspools built actually inside the house. Out of the wine cellars of one very large mansion in Leicestershire, I removed seventeen different cesspools each full of solid ancient filth. The practice had evidently been after filling one to dig another contiguous to it, and so on connecting each to the drain acting as an overflow—which in this case was a brick one upwards of a quarter of a mile long—until as time rolled on a later system of drainage was resorted to.

The material taken from these very old cesspools has something of a consistency such as that of soap, and emits but little smell, but the moment it is exposed to the atmosphere, and especially to rain, they give forth the direst odours, quite as bad as those given off by unventilated cesspools of more recent date whilst being cleaned out. Fortunately for our forefathers the water-closet was unknown, and these cesspools were robbed of one deathly factor, inasmuch as their cesspools were not necessarily converted into foul-air gasometers, where introduced germs of disease could multiply.

In all towns founded in olden times the cesspool was common, and was intended to hold the more solid wastes after some such a manner as that described ; and after the introduction of water-closets they were frequently still continued in use. It is however in the West-end of London especially where these old systems can best be studied, when peradventure some householder has demanded an exploration of his house.

Cesspools will very often be found to have overflows in connection with the older sewers, but it is quite impossible without searching for them to say where they may be found —generally at the foot of the stairs, or the centre of the kitchen, the latter being apparently a favourite place. They are not very frequently found to receive the sewerage of the present day, but nevertheless they will be discovered to be in connection with the old brick drains. Obsolete cesspools of this class will sometimes be discovered inside new houses, owing to the builder, after having taken down the old tenement, having built the modern one on the same site without having searched the subsoil, or even removed the old brick drains. Cesspools were, however, built in London to receive the solids after the introduction of the water-closet, and huge ones too, for last year I discovered one in a fashionable residence off Oxford Street, which measured some 20 feet long, 12 feet wide, and 10 feet in depth, the overflow going into the sewer. The solids carted away from this cesspool measured over 20 cart loads.

If it be advisable to abolish cesspools close to a country house, they should be remorselessly dealt with in houses in town. Nor should the word of the mere drain-layer be taken for it; for having occasion in an old West-end square in London to examine a new system of drainage which had just been completed, I came across an old cesspool in the basement passage, which the builder had not attempted to remove or clean out, but had simply bridged it over by placing his pipes upon a piece of wood.

In some cases care has to be exercised in opening old cesspools, because the drain gases contained in those which have never been ventilated are of a very inflammable nature and cause severe burns. On one occasion, in Surrey, I warned a man not to open an old cesspool of this character, which had just been discovered, with a lighted candle in the place, and his neglect to follow my advice laid him up for some days in a hospital.

With regard to that class of outfall (2) into open ditches, streams, or ponds, it will not be necessary to say much, because it is to be supposed that the outfalls are sufficiently remote from the dwelling, and that the offensive matters borne away from the house have first of all had their solids intercepted in some suitable manner, and that the rest can be subjected to oxidation by the atmosphere without causing a nuisance, which however is very seldom the case. This class of house in the country can always be treated under Class 3, viz. by making use of the liquid sewage upon the land by some system of irrigation. I will say no more as to this last class, because it will form one of the subjects in the Appendix of the Handbook.

There remains now but Class 4—drainage into sewers of towns and cities, with the construction and the maintenance of which the householder has nothing to do. His house is supposed to be connected with the sewer, and if he has reason to believe that any offence proceeds from it, he has or ought to have, in case the sewer is at fault, his remedy at the hands of the parish authorities. It is very seldom that much fault can be found with the town sewers, because as a rule they are amply ventilated. Nevertheless there are in some towns lengths of sewers which have been laid down almost level, and which are not self-cleansing. These, however, will disappear in time, as they are sooner or later replaced by the proper persons in power.

Houses in connection with a large brick sewer have usually what is called a flap-trap, just where the house drain enters into the sewer, and this flap opens to allow of the house sewage entering the sewer, whereupon it should immediately close again to exclude foul air and rats from invading the house. They sometimes, however, do not shut closely, and in that case their action for good is almost at an end. When a householder drains into a sewer through such a trap as this, it would be wise for him to have an occasional inspection made of the trap by some of the sewer men, which he can always do by paying a small fee to the Vestry.

DISCONNECTION OF HOUSE DRAINS.

No matter whether the house drains into a sewer, a stream, a cesspool, or upon a piece of irrigation ground, there is one thing which must never be omitted, and that is the providing of a disconnection-trap or chamber between the house drain and the outfall. By means of these traps or chambers—which should preferably be placed close to the house—the syphon in connection with them prevents any smell from the outfall passing into the house, and inasmuch as they have an inlet for the taking in of fresh air between the syphon and the house, this fresh air will course along the underground drains, and be discharged at the ventilating continuations of the soil-pipes, or at the tops of the upright ventilating pipes, which should be placed generally at every end of the house drain. There can then be no stagnation in the house drain.

There are at present in the market several patterns of traps with this fresh-air inlet on the house side of the trapping water—notably Buchan's, Weaver's, and Angell's —by the adoption of which, and the fixing of an upright pipe fitted into the fresh-air inlet, and brought up to the ground level, a current of air can be obtained for the house drain of a small dwelling.

In the larger houses, however, the sectional area of the air inlet in these syphons is not sufficient, and therefore instead of the air inlet being confined to the form of a pipe, an open chamber having a half-round drain-pipe at the bottom is fixed, and a volume of fresh air is led into the open chamber. One of the best kinds of a disconnection chamber of this kind is drawn at Fig. 20, and here the sewage constantly passes into the air-chamber formed by the half-open pipe C, through the open grating on the surface of the ground at D, and after traversing the underground drains is discharged at the ventilating pipes beforementioned. The sewage passes through the chamber C, and through the syphon A, and finds its way to the sewer in the direction of the arrow. The best syphons for building air-chambers of this description have a raking entry into the sewer side of the syphon, as shown at B, which is

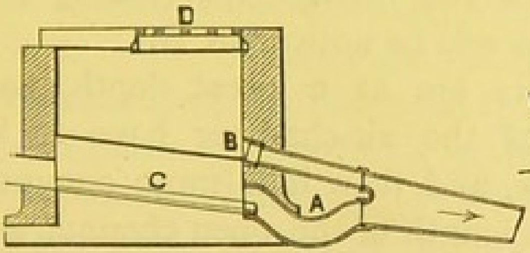


FIG. 20.

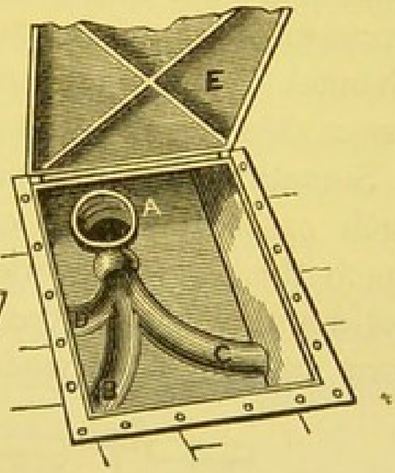


FIG. 21.

closed by a plug, or what acts as such, thus preventing any smell from the sewer or drain, beyond the syphon, reaching the air-chamber C. Should it be apprehended that a stoppage exists between the syphon and the drain leading to the outfall, the plug is removed from the raking orifice B, and jointed rods can be pushed through to the sewer or other outfall. In a similar way the same rods could be pushed up the drain in the other direction, namely, towards the house, which is the direction the introduced fresh air takes. Fig. 21 gives a view of a shallow disconnection chamber of this kind opened up for inspection by lifting up the iron man-hole E. It will be seen by this sketch that several drains can be taken into the syphon by curves B, C, and D, laid in the open chamber, and these curved open channels are now made by many firms. It is not usually necessary to expose the syphon itself in the air-chamber, because it can be reached by the hand from the open channel. The mouth of the raking pipe leading to the sewer side of the syphon will be noticed at A.

Sometimes the sewers are at a great depth, and in such cases the walls of the air-chamber have to be of much thicker brickwork, and then it is more common to build a man-hole of the length of the open channel, and to turn an arch over where the syphon is fixed, as drawn at Fig. 22. As in the more shallow disconnection chamber shown at Fig. 20, the sewage passes from B through the syphon A, and on to the drain extension or sewer beyond C.

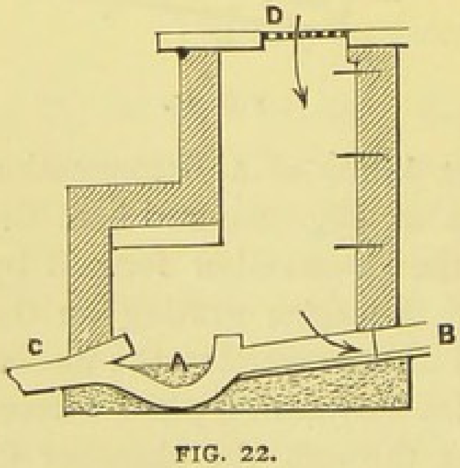


FIG. 22.

Both Figs. 20 and 22 show the inlet of fresh air passing through open gratings on the ground level, but it is not always wise to introduce the air in this manner, and very rarely so in towns, in which latter cases the air is admitted by way of pipes taken into the interior, and the open iron gratings D would be covered by an air-tight man-hole such as that shown at E, Fig. 19, where I have introduced such air-tight man-hole to avoid the necessity of another wood-cut. The inlet of air into the air-tight covered disconnection chamber, shown at Fig. 21, is by way of an underground pipe.

It cannot be reiterated too often that an efficient disconnection chamber of some kind or another should be provided for every dwelling which communicates with a drain of any kind, whether in town or country. No house can be said to be properly drained unless a chamber of this kind be inserted between the house drain and the sewer, or any other kind of outfall, neither will any responsible man certify a house as being in a healthy state of drainage except such a chamber, or a syphon with suitable fresh-air inlet, has been provided.

As a matter of course there are many points of detail in connection with the working of these air-inlet chambers which require to be studied, but I will only mention one, and that is the necessity for diluting the air between the air-chamber and the house when a long space intervenes between them. This tends to keep the air fairly fresh, and in country houses it will often be found necessary when the delivery end of the syphon is a long distance from the outfall, to frequently ventilate the drain, or what might then be fairly termed the sewer.

FLUSHING OF DRAINS.

The flushing of drains, not by merely passing a constant stream of water through them, but by delivering periodically a large volume of water into the drain, so as to well scour it inside, and remove all obstruction, has been practised for many years, and some contrivances found in country places to bring about this complete flushing are most ingenious. It would be impossible to describe the many contrivances which exist at the present day, and which have been invented for flushing out underground drains. Some are mere boxes, which tumble over when the fluid contents reach a certain figure, whereas others make use more or less of the ordinary syphon. The object of all these inventions is to deliver the flushing water automatically when the tank has become repleted with water; and so fast has invention been exercised in respect of these flushing contrivances, that the Patent Office has lately been recording two or three of them monthly.

In some cases these flushing cisterns are placed on the top of the house, and when their contents are liberated, they are delivered down the soil-pipe or other pipe leading to the drain, which latter is commensurately flushed to the outfall. This method of cleansing a drain is, however, very little practised, and preference is given to tanks just above or just below the ground level, where water can be collected at the heads of the drains, in order to cleanse such drains. An example of a flushing tank of this description, which delivers automatically, and which is known as Field's Annular Syphon Tank, is drawn at Fig. 23, which represents a tank of galvanised iron, holding any number of gallons — 100 gallons is most usual—and the water is introduced into the tank by a constant dribble from the tap A. When the water has risen to the top of the longer limb of the syphon B, it overflows, but instead of running down the sides it is thrown off by a lip, and is caused to descend clear of the sides, by which means a quantity of air is displaced, which gradually forms a partial vacuum in the discharging limb sufficient to start the syphon, whereupon the whole of the contents of the tank C are discharged into the drain D. It can easily be understood that the tap A can be so arranged as to fill the tank either almost immediately, at the end of several hours, or but once or twice during the day, and by this means the drains can be flushed out after any given interval of time.

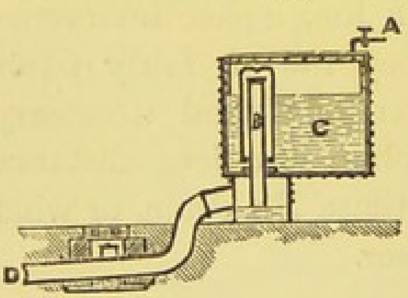


FIG. 23.

In the case of many mansions and country houses, very considerable lengths of drain have to be flushed, so that a larger flushing tank is required, and it is then advisable to have a different form of flushing tank. Fig. 24 represents the kind of tank usually constructed in such cases. Instead of being of iron, it is formed of cemented brickwork on a foundation of concrete, and is covered either by an arch, by flag-stones, or by woodwork. A man-hole is built adjoining the tank, so that the longer leg of the syphon can be examined and cleaned. This form of flushing tank is particularly applicable where, as is sometimes the case, sewage coming from drains at a higher level can be made use of as a means of flushing.

When the tank is used for sewage its size must be regulated by the quantity of sewage available for filling it, so that it may be discharged at least every one or two days, otherwise the sewage would decompose, and the tank partake of the nature of a cesspool.

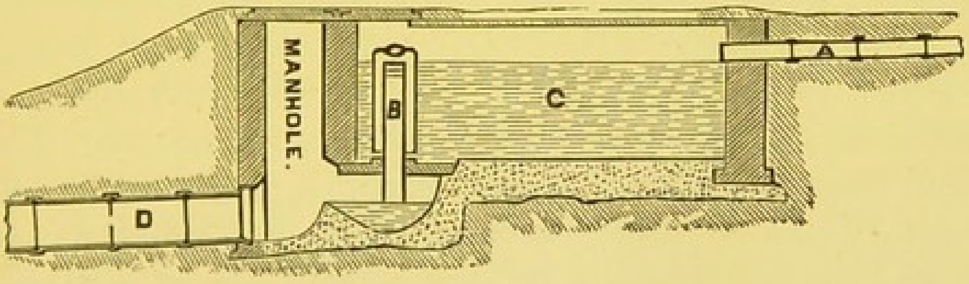


FIG. 24.

The delivery of the contents of this tank, which is drawn at Fig. 24, is brought about precisely by the same kind of syphon as that explained at Fig. 23, whereby the contents of the tank C are delivered by way of the syphon B into the lower drain D. Flushing tanks of this description are used not only for flushing drains, but also for the purposes of irrigation, as will be explained in the Appendix.

When new drains have been laid down inside a house, they should be tested for soundness of joints, which is mostly done by filling them with water, and noting whether there are escapes at leaky joints ; but such a severe test as this should not be applied until it is certain that the cement in the joints has become properly hardened. Old drains should always be tested for soundness of joints, sufficiency of "fall," and freedom from interior deposits.

Sometimes in drain testing sulphur is burnt in the disconnection chamber, and if there be anything the matter with the soil pipe, which is the only one pipe that should be allowed to communicate direct with the drain, the escaping sulphur will indicate where the fault is to be found. The condition of the soil-pipe and drain can also be tested by pouring a little oil of peppermint mixed with hot water down the top of the soil-pipe, and should any weak place exist at the joints or elsewhere, the volatile oil will be immediately detected in its neighbourhood. There is also another test applied from the bottom of the drain upwards, and that is by generating smoke from burning brown paper, and searching for any presence of it in the house interior.

CHAPTER IV.

TRAPS, SINK AND BATH WASTES, SOIL-PIPES AND CLOSETS.

TRAPS.

IT is not difficult to define wherein consists a trap, but it is not so easy to state where they are capable of doing service, and under what conditions they are not to be relied upon. In a work published by me in 1872,* I figured over a hundred different kinds of traps, which were all that were then known in the market. Syphon-traps, dip-traps, lip-traps, ventilated-traps, inspection-traps, and disinfecting-traps, and what traps have since been invented are only improvements on those which have gone before. These adjuncts to sanitation were almost all provided before 1870, by which time the rage for traps had nearly expended itself. At the present day the traps absolutely necessary in order to render a house healthy need not exceed half-a-dozen in number. Traps were originally invented for the purpose of keeping back smells arising from foul drains and cesspools, and are used in this respect even yet, but under other than the original conditions, and the rule is now to look upon all traps with suspicion, and to make use of them only after cogitating as to how exactly they would work.

The primitive trap was the trap shown at Fig. 25, and is known as the dip-stone trap, or mason's trap, which is the most dangerous of all trapping devices. The sketch exhibits one of the oldest Edinburgh street traps, and it can easily be seen that, but for the thin piece of stone in the middle, which impedes the passage of the air from the sewer to the house drain,

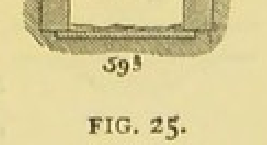


FIG. 25.

---

* 'Healthy Houses.' London: Simpkin, Marshall & Co.

it would be a simple cesspool. Even with the dip-stone, which forms the trap, it is little better than a cesspool, because the solids remain at the bottom, and the liquid wastes only can reach the sewer. Half of the trap at least is a veritable cesspool, and the trapping water can never be clean water, as every hydraulic seal should be. The gases from the sewer and the foul air derived from the foul sediments at the bottom have, despite traps of this description, a highway into the house drain.

Traps of this description are nearly always discovered in connection with brick drains, and in town houses they will be found generally inside the house, or in the area vaults. In the country they are more frequently revealed outside the residence, but this does not in the slightest degree palliate the evil, nor would it be removed were the trap well ventilated. The fault would always remain, because the foul solids and the gas-delivering water are retained in the trap or cesspit. When any dwelling which is connected with a drain is invaded by foul smells, a trap of this kind is almost always the delinquent. These horribly-contrived trapping media should be sought for before residing in any house, and replaced by modern syphons. And it is most disgraceful that many builders, both in town and country, even at the present day, build these monstrously large cesspits, by way of traps between the house drain and sewer. Within the last few years I have seen perhaps a score of these deathly traps built in conjunction with new drains.

A great advance in traps was made when the common syphons, such as those shown at Fig. 26, were given to the sanitary world, but even these are not immaculate. The lower one is without a means of access to it when laid in a line of a drain, and the upper one affords this; but both offer alike but very feeble resistance to the passage of deadly gases from cesspools or faulty sewers, which soon force a passage through the small quantity of water trapping. They are, moreover, very apt

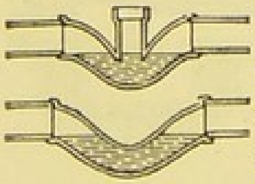


FIG. 26.

to fill up, owing to the want of an extra "fall" in the pipe, just above the syphon. The utmost ignorance prevails in respect of syphons in some places, and only last year I found that a professed "sanitary drain-layer," who had been asked to put in a disconnecting syphon between house drain and sewer, had inserted the access syphon, shown at Fig. 26, in the drain, covered the inlet mouth with a stone, and had argued that a better disconnection could not be found. I introduced to the "professor" the Buchan and Weaver air-inlet syphons, which are used with many others—in true disconnection,—but did not convince him of his ignorance. The true methods of disconnection between house drain and sewer have been noticed and drawn at Figs. 20, 21 and 22, although in small houses the inlet syphon can be used without any open channel pipe.

Shortly after the introduction of the syphon traps of the kind drawn at Fig. 26, gully traps for insertion in the drains at the foot of rain-water pipes, and in yards and areas for the removal of surface water, were introduced. These gullies take various forms, and some of the most useful are sketched at Fig. 27. The larger ones are mostly used in garden and road drains, and these gullies being deep, permit of the collection at the bottom of a considerable amount of sand and gravel, which is, or should be, regularly cleaned out. Traps of this gully order are admirably adapted for the disconnection of sinks, baths, lavatories, and the like from the drains, thus causing these wastes to deliver over the open gratings which cover them. The best practice is to terminate the end of the waste pipe a few inches from the gully grating, and lead the wastes into the trap by way of a few inches of open channel, but that cannot always be achieved. These gullies are not intended to be used inside the house—where, indeed, no open

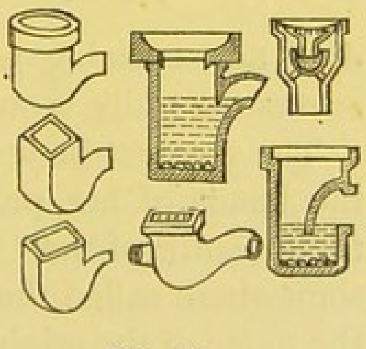


FIG. 27.

trap should ever be allowed in the floors—but they will be found useful for insertion in the floors of dairies, wash-houses, cold-meat larders, and places where it is best to swill out the floors in preference to washing them with cloths. But wherever these floor traps are inserted in connection with the house offices, the strict rule must be observed of causing each of these gullies to deliver once more into another gully outside the house in the open air, so that it cannot be in direct communication with the sewer or main drain.

The gullies drawn at Fig. 27 have one disadvantage, which consists in their outlets not being always suited to join the drain in the desired direction. To remedy this, Mr. Houghton, of London, has contrived a gully with a reversible top, which can be turned round in any direction (see Fig. 28). For instance, the outlet of the trap at the bottom of the gully can be pointed in any direction, and the inlet to the basin of the gully, which forms the movable half at the top, can be twisted round to accommodate any entering waste pipe. The open grating which covers the gully is shown beside it.

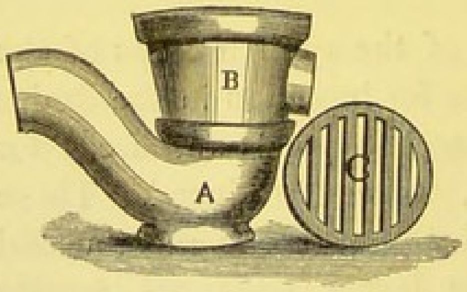


FIG. 28.

The greatest blow which true sanitation ever received at the hands of her professed servants, was administered by the inventor of the "bell-trap," which Mr. S. S. Hellyer has somewhere called the "death-bell trap." It is fortunate that the name of the originator of this trap has not come down to posterity, or he would have, in the opinion of all thinking householders, merited an obloquy equal to that measured out to Eratostratus. This trap is drawn at Fig. 29, and it can be seen in most sinks, and in many entries into the drains at the floor level. When the grating, with its attached inverted cup, is lifted off, the house is in direct communication with any undiscon-

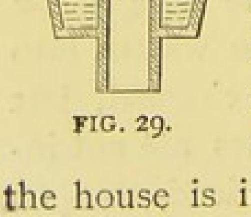


FIG. 29.

nected or unventilated drain, and even when the cover is down in its place, the water seal is so shallow that it is soon rendered useless by evaporation, or by silting up with grease or sand. If all the bell-traps at this moment were examined throughout the country, I verily believe that one half of them would be found without the inverted cup which forms the bell, or otherwise inoperative as traps.

One of the points upon which sanitary men most disagree, is the necessity or non-necessity for traps which shall collect the grease from the scullery sink, and so prevent it from filling up the drain. Were the scullery sink delivering into a drain quite close to the sewer, the globules of fat might ride on the water and be taken within the jurisdiction of the sewer rat; but very often the scullery sink wastes enter the drain at the far end of the house, and remote from the entry into the sewer. The fatty matter will congeal and solidify, and adhere to the sides and bottom of the drain pipe. This being granted —and experiments made by Dr. Russell have proved that grease will only travel so many feet in the best laid drain —the question arises as to where such grease-collecting traps are positively necessary. Well, never in cottages, seldom in small houses, sometimes in the larger dwellings and villas, where cook and scullery-maid reign below stairs, and always in houses where the number of servants outnumber the family. This is a very skeleton definition, but it is all my space will allow. Where a grease-collection trap is necessary, unless that accommodation be rendered, the underground drains will choke up, and necessitate their being opened up and cleaned out. The need for a grease chamber is enhanced when the culinary utensils are scoured out with sand at the scullery sink, and if a chamber be not provided, the drain will clog all the sooner, as the sand does not get to the sewer, but becomes embedded in the grease. Besides, how careless are some servants—I have actually seen the contents of the stock-pot, full of fat, deliberately poured down a scullery sink!

If a grease-collecting trap is necessary, care should be taken that it be not too large for the work which it has to perform. A small house, where several servants are kept, might be well supplied by a Dean's intercepting trap, a larger one by a Doulton or Houghton grease-trap, and a still larger residence by a Hellyer grease collector, but I regret I cannot afford room for illustrations. In large mansions with a retinue of servants, it is sometimes necessary to provide still larger chambers, and then they are built up of brickwork in cement, rendered smooth inside with a cement lining, and covered over with an air-tight man-hole cover. A large grease chamber of this kind is given at Fig. 30.

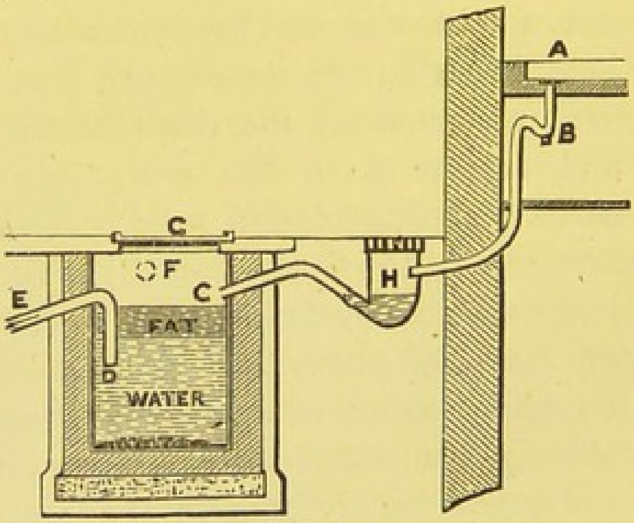


FIG. 30.

Here the scullery sink is shown at A. An access syphon trap just under at B, and the delivery of the grease-laden water into the chamber is shown at C. The pipe leading to the sewer terminates at some distance down in the water, as shown at D, and thus the buoyant fats will remain between D and C, and only unladen water will reach the sewer; as for the sand, it will sink to the bottom of the chamber. The whole is covered by the air-tight cover G. Such a trap should be placed outside the house, whenever in any way possible; but unfortunately some houses, and in London especially, there is no open yard available, in which case the chamber can be ventilated by means of the pipe F. Ventilation is not always to be obtained, except at the risk of the smell reaching the rooms of the house when the scullery is close below; but some kind of ventilation, if only from the trap just under the sink, is now thought necessary, if only to remove the steam. An extra precaution can be provided in country houses, by interposing an ordinary gully between the scullery sink and the grease chamber with its outgo E.

Whenever a grease-collection chamber is provided, it is of the highest importance to have it regularly cleaned out. The smaller stoneware gully-shaped collectors require emptying of their fat about once a week, and the larger ones had better be attended to once a fortnight. As for the still larger ones they should be emptied once a month if possible—certainly once in every three months. It will be found wise, in large establishments, to order these grease chambers to be cleaned out on the first day of every quarter, and if this be neglected, the fats will likely enough reach the drain, and begin to choke it. Just as a clock requires winding up, so does a grease chamber need periodical attention, and it is quite as easy for servants to bear this in mind, as it is for them to remember that their wages are due on a given day.

WASTE PIPES FROM SINKS, BATHS, AND LAVATORIES.

Unless the house has been within the last few years wedded to Hygiene by some competent authority, who has seen that all the rubrics of health have been carried out, it will be found that the wastes of the sinks, baths, and lavatories transgress most terribly. Either these wastes will be found to deliver connectedly with the drain direct, or with the soil-pipe, or they will be found to have been taken on to the trap of a closet. People are, however, nowadays, so well acquainted with what is right, that the moment they hear of such dangerous communications between the waste pipes and the drain, they do not remain satisfied until they are assured of matters having been put right. I should say that ninety out of every hundred houses sin against sanitation in respect of the treatment of their waste pipes from sink, bath, and lavatory, and instead of these being disconnected over a gully such as shown at Figs. 27 and 28, so that the waste water can be seen in the open air, they communicate with the foul drain, and become the vehicles whereby pestiferous smells are introduced into the house. In order not to waste the reader's time, I will merely give one example of this dangerous association of waste pipes with foul conduits. This example is drawn at Fig. 31, from the trap of a closet taken by me from a gentleman's house and now in my possession. It is the greatest sinner against health that ever I beheld. It can easily be understood that such a trap as this, which was placed under one of the worst forms of closets, must have been a nest of indescribable filth, and that owing to the faulty construction of the trap, the excreta from the closet which passed into the orifice of the trap at A, and was intended to join the soil pipe at the extemity F, left a considerable amount of soil behind it. But it would hardly be credited that into this most foul receptacle, and positively into the trapping water of the trap, was taken by the pipe B the waste of the cistern which supplied the closet, the pipe C which removed the wastes of a lavatory in the closet-room, the pipe D which brought down the waste from a bath in the floor above, and the pipe E which conveyed into the soil-pipe the waste water from the housemaid's sink on the nursery floor. Need it be wondered at that such a state of things eventuated fatally to the household? With this example in

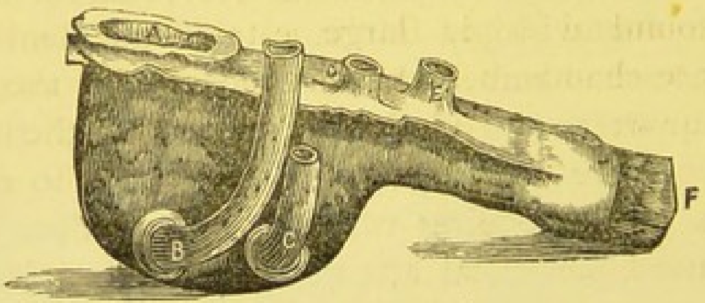


FIG. 31.

view, it becomes the duty of every householder in town and country alike to examine exactly where the wastes of his cisterns, sinks, baths, and lavatories go, and to make certain that they positively deliver in the open air. No one waste whatsoever which issues from a house — the soil of the closets alone excepted — should deliver into the drain otherwise than over or into an open gully trap, and wherever this rule is neglected, evil will some day or another ensue. Sometimes it may be permitted to lead such kinds of wastes into a rain-water pipe, when the latter delivers disconnectedly, but I will show under the head of rain-water pipe treatment, that this alternating system can be abused.

It is customary with some to repudiate traps altogether, and to rest satisfied with taking the waste pipe from a sink, or lavatory, or bath, so as to make it deliver over a gully, and not to fix underneath these services such a trap as is shown at B, Fig. 30, and which is known as an access trap. It is true that traps are greatly misunderstood, and too often relied upon to keep out drain air, and so attempt to take the place of disconnection, which they can never do; but there is, nevertheless, a duty for them to perform. For instance, supposing the waste of a housemaid's sink to be taken down to a basement yard gully from the third story, there will then be some 50 feet of waste pipe between the sink and the open gully, and unless the sink be trapped underneath the accretionary slime of decomposed fats of soaps will soon attaint the room in which the sink is placed, more especially when the outer air is coursing up the waste pipe into the warm room. And even when the sink is on the basement level, quite close to the gully trap, it will often happen that during the summer, especially when the trapping water is not kept clean, a certain effluvium will be engendered, and there being no trap under the sink, it is sucked into the house.

In order to overcome this tendency of even the less objectionable order of smells to storm a house, I have lately, as well as providing a trap, continued the waste pipe up beyond the entry of the service, ventilated the pipe, in fact, and provided a highway for a constant current of air through it, by this means staying the influx of any air into the room by way of the waste pipe.

There are many questions in connection with traps, which cannot be expected to be understood by a lay mind, and which are only intelligible to those daily accustomed to deal with them. One of the greatest mysteries finds its centre in what is called syphonage; but the history of this is too abstruse for these pages.

SOIL-PIPES.

The soil-pipe is that conduit which conveys the soil from closets to the underground drain, and it makes a law unto itself which cannot be broken with impunity. This law is comprised under several rules, which sanitarians very well understand, but which are often broken, to the great detriment of the householder. These pipes may be of earthenware, iron, or lead, and the last mentioned is certainly the most reliable. With some builders it has been a practice to erect earthenware pipes in upright chases formed in the walls, but this plan has happily now grown into desuetude, because it has been found that a cement joint will not remain intact, and because any settlement of the walls of the house, owing to weak foundations or any vibrations due to contiguity with a railway, are apt to result in a fractured pipe. When cast-iron pipes are used for soil conveyance, and when they have been built in the wall interior, they are apt to open at the joints from irregular expansion and contraction, and moreover they too frequently crack, and allow the liquids to escape. In town houses where the soil-pipe cannot be seen, it is a safe rule to assume that the pipe is composed of cast-iron, and in some way or another indications of its presence, shown by resulting rustiness, will be discovered, proving the pipe to be faulty. In such cases, the soil-pipe should be removed without delay, and replaced by a leaden pipe of proper stoutness. It may happen that an iron soil-pipe built inside a wall will be found perfectly sound, but it is always safest to doubt this, as very frequently a weak joint will be found just between the joists, thus conveying the smells over that whole system of flooring. On one occasion in Cornwall I discovered that the cause of horrible smells on two reception floors arose from the faulty condition of an iron soil-pipe which had been built up in a wall, and I detected the whereabouts of the mischief by taking down the closets and plugging up the entries into the traps leading to the soil-pipe and by filling it with water. This is a most crucial test, and the result in this case was that the oblique course of the pipe was revealed by the wetness, which had penetrated through the wall and papering, and had extended along one or two of the ceilings. This severe test is, of course, known to all practitioners, and I only mention it here, because the householder should be aware of it as being the last resource.

Soil-pipes of cast-iron may work fairly well, provided they are erected outside the house and very carefully jointed, but the great difficulty lies in the careful jointing, which is hardly ever to be achieved when the ordinary thin rain-water pipe is used for soil conveyance. Pipes of such weak material can never be properly jointed, and no amount of yearly painting will render the joints beyond reproach. Owing, moreover, to the cost of the jointing, and their frequency in a long length of pipe, intelligent builders prefer to make use of leaden soil-pipes, which run in lengths of ten or twelve feet without any necessity for jointing, although they require more upholding in consequence of their greater weight.

The best of all material for a soil-pipe is undoubtedly lead—what is termed " drawn " lead, and not milled sheet lead with its necessary upright solder joint. These solder joints are the very first places attacked by sewer gas, and lamentable have been the consequences to the health of the inmates from the perishing soft solder and the opening of the joints, especially when such pipes have been fixed inside the house. The golden rule with regard to soil-pipes is to fix them outside the house whenever this can by any means be done, and to use drawn lead pipes instead of soldered-up pipes. One can easily understand that the architecture of some house elevations will scarcely admit of round pipes with plumber's common wiped joints, but still these unsightly joints can be hidden by ornamental clips; and should necessity compel a simulation of a rain-water pipe oblong in section, even that can be resorted to, although it does not clear itself so well as a round pipe.

One thing in connection with soil-pipes is indispensable, and that is its continuance up to the roof—remote from windows and chimneys—in full sectional area. It is very rare that even a three-inch continuation of the soil-pipe will suffice for its proper ventilation, and anything of less diameter is useless. With regard to the fixing of any cowl on the top of the pipe so as to create an induced current up the pipe, opinions greatly differ, but certainly some provision should be made there in order to prevent the nesting of birds at the summit. The ordinary extinguisher-shaped finial is the worst of all things to adopt, and an open wired globe will generally be found sufficient.

Although the soil-pipes of closets, when ventilated, do not in every case afford sufficient ventilation to the drain, yet, nevertheless, it is always imperative that they should act as escape pipes for the air in the drains, and that they should work in conjunction with the disconnection chamber, with its fresh-air inlet between the house drain and the sewer, previously alluded to. The abuse of rain-water pipes by causing them to act as soil-pipes as well, thus thrusting a double duty upon them, will be mentioned when dealing with rain-water pipes.

WATER-CLOSETS.

With the introduction of the water-closet and water-borne sewage—indisputably necessary, however, where people in large towns have to be fed, housed, educated, and enriched all in the smallest possible space—has come a multitude of evils in the form of disease; and one of the prevailing questions now in respect of a house, is how that house shall be properly closeted.

In a very clever little volume published last year by Mr. Ernest Turner, the architect, he says that the plethora of works upon sanitation has been so great, that it has become a weariness, "not only to the flesh, but to the spirit." But I disagree with him here, and I think that some hundreds more volumes will have to be written long after we are buried or cremated before the lieges of this country have completely grappled with this great question, or even come to properly appreciate the difference between a good closet and a bad one.

Without doubt the very worst pattern of closet extant, is that known as the "pan" apparatus, and most unfortunately it is that which is almost universally adopted, and probably, both in town and country, it is the pattern which will be found in thirty domiciles out of forty throughout the land. I give at Fig. 32 a sketch of this closet, which will be seen to be made up of three parts; A, the basin, which is all that is exposed to view; B, the container, in which the moveable pan works which holds the water, visible when looking down in the basin; and C, the "D-trap," with its eject D into the soil-pipe. When the closet is being used, the contents of the basin A are simply splashed out of the pan against the interior of the receiver B, and there the soil partially adheres, and another fraction is caught in durance in the interior of the D-trap C; in consequence of which the filth in the D-trap and in the container is always giving off foul air, which is certain to be delivered straight in the face when the handle of the closet is lifted. Such closets, with their filthy basins, filthy pan soffits, execrable gas containers, and abominably unclean D-traps, would require to be taken to pieces at least once a year, in order to have the corrosive filth burned

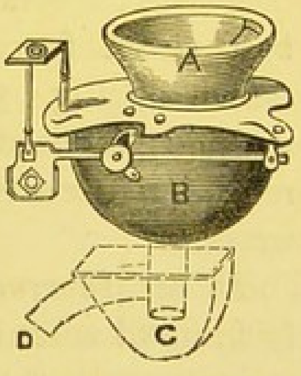


FIG. 32.

off by fire; and, therefore, this pattern of closet should never be adopted. No amount of substituted earthenware in its component parts will compensate for its drawbacks in respect of shape; and were even the D-trap below abolished, and a cleanly syphon trap introduced, it would still remain vile and a storer of foul air. Many builders consider this the best pattern of closet for the use of servants, but if there is one thing more than another which should be provided for servants, a cleanly closet is the most indispensable.

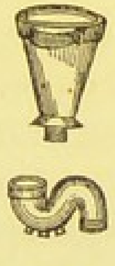


FIG. 33.

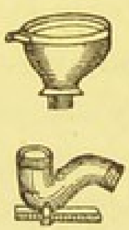


FIG. 34.

There is another form of closet much adopted for servants' use, known as the deep "Hopper" closet, drawn at Fig. 33, and this is in some respects as bad an apparatus as the pan pattern, because it does not permit of a flush of water sufficient to clean out the syphon, which is shown below it, and to which it is attached. Closets of this description should be rigorously excluded from a house, as they are a constant source of chokage in the drain. The best closet for servants, for outdoors especially, is that drawn at Fig. 34, the whole of the surrounding rim of which is scoured with the flushing water, by this means removing the contents of the basin right away into the sewer.

There are several scores of closets purchasable, which fairly fulfil what is required in respect of maintaining their cleanliness, and among these may be classed what are called the "wash-out" closets, which are mostly formed of one piece of earthenware, thus obviating the necessity for working parts of metal. It would be invidious to give a list of these, and any builder—in towns at all events—is now conversant with them; and the publicity which waits upon exhibitions, where their merits are rewarded by medals, is fast making these happier designed goods known, even in remote hamlets. There is a class of closet constructed in one piece of earthenware, which is very widely patronised, and which will always command a sale where plenty of flushing water can be allowed, and that is the "Jennings" closet, drawn at Fig. 35. The latest improvements introduced into this closet have brought it to a high state of perfection, and it is to be commended for nursery purposes especially.

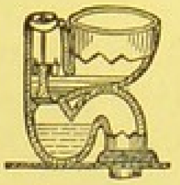


FIG. 35.

The best kind of closet for general use in a household is the "valve" closet, which is sketched at Fig. 36, and it is a curious thing that this class of closet was invented by Mr. Bramah, previous to the introduction of the foul "pan closet." Its greater costliness led to the foisting of the latter upon the public, but thanks now to competition, and the cheapness which follows a great demand, improved closets of this order can be obtained for very little more money than has to be paid for the "pan closet." It should be an instruction to the builder, when asked to fix a closet of this class, to make choice of a pattern which fills the overflow pipe every time the handle is lifted up to deliver the flushing water. Above all, he should be warned not to fix a D-trap under the apparatus, but only a P-trap, or an S-trap, of cast lead. Fitted up in this way the closet will be found a most excellent one, and, as a matter of course, the ornamentation of the basin and the character of the fittings, which are visible, can be brought up to any level of requirement.

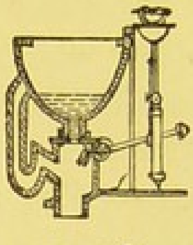


FIG. 36.

Besides making sure that the closet has no D-trap, which, as has been explained, is the filthiest form of trap, care should be taken to make sure that the waste pipe from the leaden tray, or "safe"—which is usually placed under a closet in order to avoid any damage to the ceiling below should the basin overflow—is not led into the trap underneath the closet, but rather taken, no matter at what expense, direct through the outer wall, and with a small copper flap at the end of the 1-inch pipe, in order to keep out the cold air. A sufficient supply of flushing water is also indispensable, and many houses can be much benefitted in this respect by simply enlarging the service pipe which conveys the service water to the basin.

Everyone in town or country, the interior of whose house is fitted up with water-closets, should ascertain whether they are pan closets with D-traps, whether the waste of the "safe" enters any kind of trap, whether the soil-pipe be ventilated and free from leakages, and whether there be a sufficient flushing water supply. With regard to the closets outside the house he should ascertain whether they are of the "pan" or "Hopper" order previously described, and should in that case introduce a "wash out" closet of some kind well supplied with water by what is called a self-acting flushing-box, which is a small cistern holding about two or three gallons, and which requires only a touch of the depending chain and ring in order to liberate this amount of flushing water automatically.

Fastidiousness has been exercised by closet inventors in order to anticipate every objection which could even be imagined, but it would be useless to dilate upon this. There is one point, however, which should be attended to, and this is the making certain that the space behind the wooden framing of the closet is kept clean, for whenever a basin overflows, or a faulty bedding down of the closet occurs, the floor or "safe" under the seat will be filthy and cause foul smells; and in cases where the closet woodwork is not made easily removable, but where a multitude of screws have to be extracted before the woodwork can be taken apart, this uncleanness often goes on for a long period, and is attributed to something else.

Within the last year a closet has been introduced without any enclosure at all, for this very reason, and it has met with some considerable encouragement. A naked apparatus of this kind, however, would never suit the best rooms of a house; nevertheless a feeling of security might lodge in the mind of a very precautionary person were he to know that closet enclosures are really to be purchased which provide for a constant air current behind them. Such a contrivance is drawn at Fig. 37, and was introduced by

Mr. T. Waller, of London. Here the cover is inclined, hinged at the back over the seat, and a space is left between the cover and the seat-top, which is placed in connection with a foul air duct at the back of the closet, with a divided mouthpiece, so as to clear not only the space in which the apparatus stands, but also that above the seat. I figure this simply to show what has been done in the matter of closets, but must not be held as saying that such extra precautions are necessary once in a thousand times.

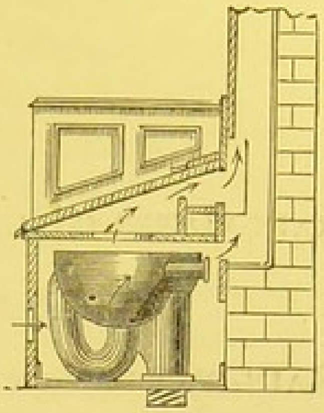


FIG. 37.

SLOP-CLOSETS.

It is a pernicious habit to make a regular practice of emptying chamber slops down the house water-closets, because the liquids find their way between the rim of the basins and the seat, and either fill the "safe" under the closets—which is out of sight—or saturate the woodwork of the floor. It may be that in a small house where there is only one closet, and where cleanliness can be enforced, and where the wood framing which surrounds the closet can be instantly removed, that a separate slop closet would not be required; but in the case of large houses some storeys high there ought to be a proper slop-closet provided for each bedroom floor down which bed-chamber slops can be emptied. Under certain conditions such a slop-closet can be connected with the ventilated soil-pipe, because the wastes are not of that cleanly character that will permit of delivery in disconnected fashion over an open gulley in a small cramped yard or area such as prevails in towns. It would be different in the country in most cases, and certainly the chief thing to aim at with all wastes, not even excepting closet soil, is to disconnect them as speedily as possible. Such waste pipes should also have ventilating continuations.

CHAPTER V.

RAIN-WATER COLLECTION AND DRINKING-WATER SUPPLY.

Rain-water Collection.

Rain-water pipes as a matter of course are always required to remove to a sufficient distance from the foundations of a building the rain- and storm-water which descends upon the roof and walls. In town houses this water is generally taken into the drain eventually, but this can be done in an improper manner both in town and country. In the majority of cases where the building is of more or less ancient date, the rain-water stack pipes deliver directly into the drain, and in still modern times, say within thirty years or so, the custom was to fix a trap at the foot of these pipes, and rely upon this hydraulic seal as being able to entirely prevent the passage up the pipe of foul air derived from the sewer or the decomposing matters in the house drains. It is sometimes permitted to lead the rain-water pipes directly into the drain, and cause them to act as ventilating pipes as well as rain-water pipes, but this can only be done in very few cases, as for instance when the head of the rain-water pipe is above all windows, when the pipe terminates behind a roof parapet where there are no dormer windows or skylights, or when it is fixed against a blind gable wall where there are no windows near and no chimneys immediately above. It is too common to find the heads of rain-water pipes—which are in direct communication with the drain and sewer—at almost the same level as the uppermost bedroom windows, and thus venting, whether they be trapped or not, the foul air into these upper rooms. The danger is still more intensified when there are dormer windows above the termination of the rain-water pipe, because the foul air which is delivered from them is sucked into the warmest rooms near the roofs upon which the sun is daily pouring its heat. In all cases where there is a fire lighted in a room the same source of danger would be present whenever the rain-water pipe terminated near the windows of the room. There is another danger accruing from rain-water pipes which connect directly with the drain, and this is due to the fact that the joints of the iron rain-water pipes are seldom air-tight, and the foul air is therefore very often driven or sucked into the rooms when the windows or ventilating portions of windows are open. It is easy to imagine how excessively dangerous this must be in all houses which have been fitted up with iron or even lead rain-water pipes which run down the interior walls, and which have their terminations close to a dormer window, skylight, or staircase ventilator on the roof, and the foot of the rain-water pipe taken direct into a drain leading to a town sewer. But the risk of encountering danger in the above cases is greatly increased when, instead of a town sewer, which is generally well ventilated, the rain-water pipes are connected with a closed down cesspool, and to which the rain-water pipe is simply acting as a ventilating medium. When country houses with the outfall of the sewage into a cesspool are examined after or during a case of illness among the inmates, it is very commonly found that the rain-water pipes deliver into cesspools in this manner, and not unfrequently death after death occurs before the true cause thereof has been discovered and matters remedied. It is the same with houses in towns, and I could enumerate several instances where, when the heads of the rain-water pipes terminated, as they frequently do, behind the parapet and underneath the attic windows, fatal cases of fever have occurred among the domestics.

Rain-water pipes are frequently made to do improper duty, and this point deserves special notice. When they deliver into the drain directly they are often made to act as soil-pipes from the closets, in which case the evils arising from the connection of a pipe conveying rain-water only are intensified, as there is then another mischievous factor to deal with. The soil from the closets is apt to adhere to the interior of the pipe—generally on the opposite side traversed by the rain-water—and the generated smell escapes at any bad joints, and always at the roof orifice. Usually this combination of rain-water pipe is due to parsimony and falsely conceived thrift on the part of the builder, and it is astonishing to notice the immense percentage of houses both in town and country which have been so treated. It would be within bounds to declare that eighty per cent. of all old houses have this dual service, and that thirty per cent. of recently erected residences are similarly circumstanced. A drive round the suburbs of London, where thousands of houses are springing up, as if by magic, every year, would, I think, satisfy the tourist as to the truth of this statement. In districts which are ruled by the strictest bye-laws the case is different, but the fact remains that this objectionable practice is far too rampant.

It is curious to note, under this head of abused rain-water pipes, how many contrivances have been resorted to in order to compensate in some way the error of treating them as conduits for clean water and sewage combined. I will, however, instance one only, and in this case the question arose with the builder—who was quite aware of the impropriety of a combined pipe—as to how best he could remedy matters and still dispense with a new soil-pipe. What he did is shown at Fig 38. The head of the combined rain-water pipe and soil-pipe was originally at A, and terminated at the eaves nearly level with the sill of the servants' windows, but the consequences being such that several ailments occurred, he cut out of the upright pipe the portion shown by the dotted line and inserted a syphon trap, so as to prevent the foul air which traversed the pipe B from passing out at the rain-water head at A. But knowing that if the pipe B, which received three entries

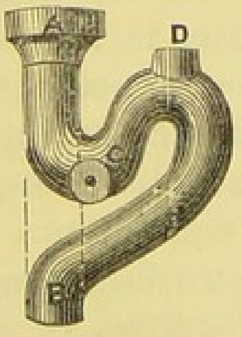


FIG. 38.

from closets, would, unless ventilated, possibly force the trap C, he carried a ventilating pipe at D from the top of the syphon up to the ridge of the roof. Cognizant, as well, that being so near the gutter, soot and leaves would likely enough fill up the trap C, he fixed there an access cap with screw, so that any silting up could be removed. The ingenuity here displayed would have been better spent in another direction, even although the result was to bring similar contrivances into the market.

Where the rain-water pipe is of cast-iron, other sources of danger are present whenever the pipe is used also as a pipe for the conveyance of soil from a closet.

It can easily be seen, unless the arm of soil-pipe from the closet is joined to the rain-water pipe by a proper cast-iron socketed joint, that the connection must be made by means of a piece of lead pipe which receives the soil-pipe, and that the joint between the piece of lead soil-pipe and the upper and lower part of the cast-iron rain-water pipe cannot be properly soldered together owing to the varying metals. It is here where sometimes grievous calamity follows cases where the combined pipe is ventilating the drain and sewer—the pipe joints are frequently open, and when the windows are unclosed for ventilation the foul air is whisked into the house. Seeing, therefore, a combined pipe, as I have called it, is liable to cause such misfortune, it must be acknowledged that it is unwise to allow the system to be employed. And I believe when all matters are taken into consideration it will be found that it is cheaper to owner and dweller alike to have a separate soil-pipe erected at first.

There can be no question that all rain-water pipes should deliver in the open air, and have no connection with the drains except when they are disconnected. They should discharge their contents over a gully grating as at A Fig. 39, or underneath the grating as at B Fig. 39, the ends of the pipes in both cases being in the open air. And there can be no doubt that every householder should insist upon this improvement being carried out, for although apparently simple, it is sometimes the saviour of complex evils. It occasionally happens, however, that the rain-water pipes descend in the interior of a house, and that there is no open yard near where a disconnecting gully can be fixed.

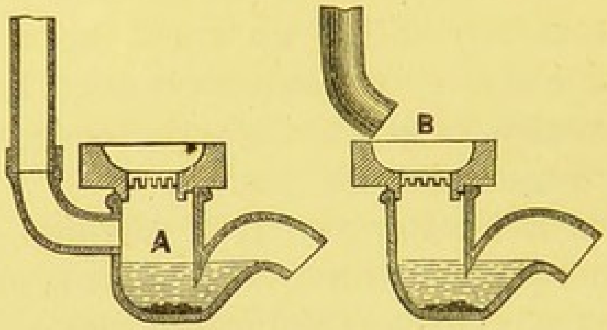


FIG. 39.

Even in that case a separate drain should be laid to the nearest area or yard and separation ensured. And in laying down new drains in a house when the rain-water pipes must perforce descend in the house interior, it will be found better to lay down a separate or twin drain to the nearest open-air space—anything rather than an entry of a rain-water pipe into the soil drain in direct fashion.

There should always be some provision made at the roof for keeping foreign matters out of the rain-water pipes. Both in the town and country leaves and other wind-strays, birds, feathers, soot, and dirt, will accumulate round the pipe orifices and very often will cause the gutter to be flooded during a storm. The usual way to avert such an annoyance is to fix over the opening of the pipe in the bottom of the gutter a galvanised open wire half globe, or a raised cap of thick lead pierced with tolerably large holes. The cost as regards money for this safeguard against mishap is trifling, but the value in respect of security is great. Only a month or so ago I noticed a continuous line of wetness down through two stories of a finely decorated house, and this was simply due to the presence of a rain-water pipe inside the wall substance, and the want of a guard at the opening in the gutter. It cost a score of pounds to make good the pipe, dry the walls, and hang up new paper. It must be conceded, therefore, that whenever rain-water pipes must necessarily run down the inside wall of a house, that lead, not cast-iron, should be adopted. Sometimes rain-water pipes are led down in the house interior, when a very little initial study could have brought them to the exterior face of a wall—where alone they should be taken, whenever it is possible to do so.

In many residences having attic roofs, and where only one side of the house can be used for the attachment of rain-water pipes, the water from one side of the building is brought across the room by means of what is called a "box" gutter of wood, lined at the bottom and sides with lead or zinc, and covered with a board. These often emit a very foul smell, owing to the accumulation of decaying matter therein, dead birds, bird ordure, decaying leaves, soot, and the like. In some cases such guttering cannot be avoided, but where it does exist, they should occasionally—say once a year—be carefully cleaned out. The same kind of adventitious matters will sometimes silt up and stop the gullies, shown at the foot of the rain-water pipes (see Fig. 39), hence it is equally necessary to see that these traps are cleaned out monthly or at least quarterly.

Rain-water pipes can be otherwise maltreated, and the necessary office which they perform made baneful to the householder. For example, they are very often made to form the waste pipes of lavatories, baths, sinks, and slop-pails. When properly disconnected at the foot, in the open air, and when the top of the rain-water pipe does not terminate under a window of an inhabited room, this might not very much matter; but the case is different when the court-yard is very limited in area, and when there is a window belonging to a living or sleeping room just overhead, where the rain from the roof delivers itself into the upright pipe. The offence in this case proceeds from the decomposing fats of soaps, which form a slimy mess adhering to the interior of the pipe, which no amount of rainfall will dislodge. The resulting annoyance becomes intensified when, in order to speedier disconnect the various waste pipes, but mainly to save lengths of lead piping, the wastes are taken into a rain-water head inserted in the upright rain-water pipe. For instance, when, as is very commonly the case, the rain-water head is interposed at A, as shown in Fig. 40, just underneath a window, and when there is taken into it the waste pipe of a housemaid's sink B, the waste of a bath C, and of a lavatory D, the slime thus generated will be enormous, and should the maid empty bedroom slops down the sink B, as they frequently do, the annoyance when the window E is opened is greatly aggravated, and will become at times unbearable, until the rain-water pipe has been cleaned out by mechanical means. Given, too, the factor due to the sun's rays beating upon the pipe, the opening of the pipe-joints due to the action of hot water running down the pipe, and the effluvium from the gully at ground level which rises up the pipe when the silt in the gully is stirred up by the descending liquids, and it must be granted that the delivery of any household wastes into a rain-water pipe, if it be permitted at all, should only be done after careful consideration. It is still more pernicious to deliver into open heads receiving rain-water, such as that at A, the soil from any water-closets, owing to the open character of the gully at the foot of the pipe.

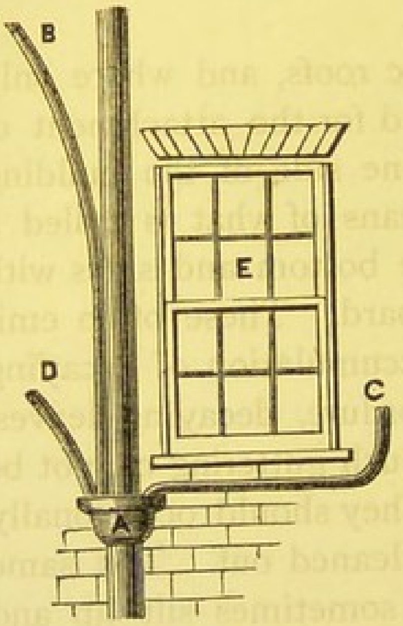


FIG. 40.

UTILISATION OF RAIN-WATER.

Both in town and country the rain-water which descends upon the roofs of houses and offices is made use of for various purposes.

When it is utilised for carriage-washing from underground tanks, whence it is pumped up, or drawn from store cisterns above ground for the same purposes, or used for flushing out drains, no filtering is requisite; but the case is altered when the rain-water is used for drinking or for laundry consumption. In such instances the water is filtered in order to remove all the many contained impurities. This filtration is effected in many ways. For instance, a system of filtering is constructed underground as shown at Fig. 41; but it is not best fitted for the improving of rain-water to such an extent as to make it absolutely pure.

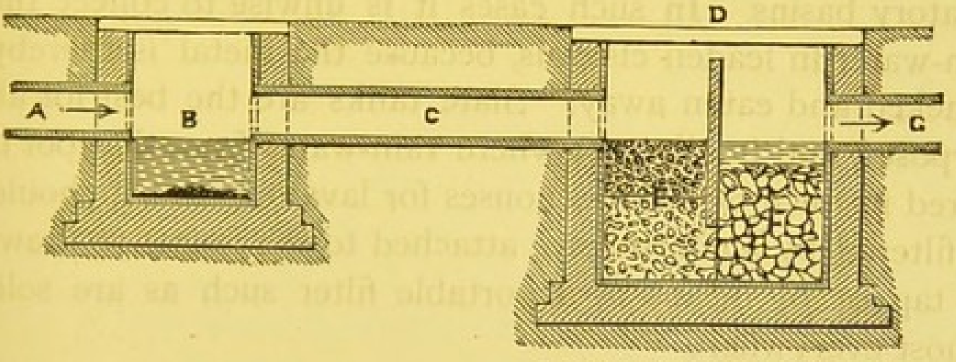


FIG. 41.

Another method of filtering rain-water for drinking and cooking purposes will be mentioned in the Appendix. The filter here shown has been several times used by me for the purpose of bringing water to such a state of purity as to serve as cleanly laundry water, or for the soft water supply of a household. Its action is in this way: the rain-water descending from the roof is first of all led by the underground drains into a small tank, where the suspended matters are mostly deposited, and the clearer water thus produced passes by way of the pipe C to the filter D, which is a chamber divided partly by a dipstone in the centre as shown. The rain-water which has passed the depositing tank B descends immediately into the first half of the filter E, which is filled with sand or coarse gravel, and rises, after passing through this material, from below into the half chamber F, and through coarser material, and eventually is removed by the pipe G to the underground storage cistern. Care should be exercised to see that the overflow of this rain-water storage cistern should not be taken into any soil-drain, or even any long drain whatsoever, until it has been disconnected first of all by passing over a gully open to the external atmosphere.

Rain-water will always be preferred for washing purposes, because it very rarely happens that the ordinary supply of the water companies is sufficiently soft. Indeed, it has become a common practice nowadays to collect the rain-water which falls upon the roof into a tank inside the roof, and to lay a service from this tank to baths and lavatory basins. In such cases it is unwise to collect the rain-water in leaden cisterns, because the metal is thereby attacked and eaten away. Slate tanks are the best for all purposes, and in all cases where rain-water from the roof is stored in town or country houses for lavatory uses, it should be filtered by a contrivance attached to the faucet or draw-off tap, or by means of a portable filter such as are sold almost everywhere.

It is a matter of some surprise to me, seeing how easy it is to cleanse the rain-water from its first impurities by means, for example, of the separator, to be described in the Appendix, and thus to render it fairly pure, why so few households, especially in hard water districts, do not take advantage of their rainfall. The adoption of soft water for bath supplies is, however, on the increase, and many town and country establishments are now fitted up with stores of soft water. In dealing with a large establishment two years ago, I collected the rain-water into a large underground tank—first filtering it—after the fashion shown at Fig. 41, and then pumped it up to a cistern in a tower, by means of a small water engine, worked by the main from a reservoir which I had constructed at a considerable level above the mansion. The advantages of soft water for ablution is also so well known now, that it is heated by boilers in the basement, and driven up to supply the baths and lavatories with hot soft water.

A very suitable system of heating soft or other water for the purposes of a house, is that of F. Dyer, of Camden Town, London. Supposing, as in the case under notice, the question was to supply heated soft water to the house, then the rain-water would be collected in the cistern A, Fig. 42, after filtering it by mechanical agency to the bottom of the cylinder M in connection with the boiler B. As the water in the boiler heats, part of it passes into the top part of the cylinder, and courses through the service- or flow-pipes C, B, and N. The return pipe D is connected with the cold water pipe near the cylinder. A rain-water supply is always of an intermittent character; but with this system of apparatus no explosion need be apprehended, as the cylinder cannot be sufficiently emptied were even a fire kept on for other purposes, sufficient water being always left there to last until after a most persistent drought. The hottest water is also drawn off at the top of the house. When it becomes necessary to clean out the cylinder and pipes, this can be done by way of the sluice K. By means of a tap fixed in the return-pipe, the warm water can be kept in circulation for use before the fire is lighted.

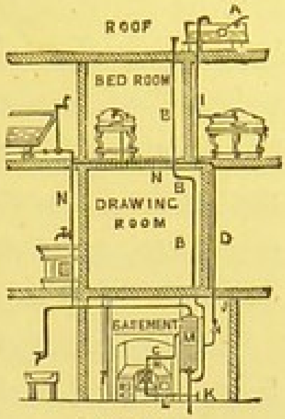


FIG. 42.

The remarks which I have made in this division of my subject, refer alike to houses in town as in country.

Drinking-water Supply and Storage.

In examining the water of a town house supplied from a reservoir of a water company, it may generally be taken for granted that the water is of such a fair standard of purity as not to engender disease, and the care to be exercised by the examiner would be mostly necessary in respect of the cisterns and the fittings, and as to whether it is possible the water can be contaminated by any association with closets, soil-pipes, or drains. In examining a house in the country dependent upon wells, it is safest to assume that the water is not pure, and to test it by submitting samples to some skilled analyst, who will be able to decide if it be impure or risky to drink, although, as Dr. Buchanan has said, the chemist cannot tell us of the "purity and safety" of a water. It would serve no useful purpose for the householder to attempt to decide between the different methods of water analysis, because this is a very vexed question, and probably the best process for the detection of impurities of all kinds has not yet been elaborated.

The presumption with regard to a well-water is that it is bad, and, admitting the necessity for an analysis from time to time, it would be well to point out how the water is best collected. What is called a "Winchester quart" should be purchased, which is a stoppered bottle of about three litres capacity, and this should be well cleansed out with strong sulphuric acid, and washed with the same water which has to be analysed, and with no other. The bottle should then be filled, corked, and sealed, and kept in a cool or dark place until sent to the chemist, which should be, if possible, within two days of the sampling. As much information should be given to the chemist as possible with regard to the position of the well, its distance from any drain, cesspool, privy, or dung-heap, the depth of the well and of the water in the well, and the formation in which it has been dug. All these things will guide him in furnishing his report.

Should the country well-water turn out to be pure, the householder will only find himself in the position of one in a town with a pure supply, and he will have, nevertheless, to make all the necessary examinations, so as to show whether it has been defiled since it left the well by any association with foul air or material. Supposing a water of good quality to be pumped up into the cistern of a house, there are, nevertheless, some methods whereby it can be contaminated, which may require a short notice. For instance, the cistern may be fouled for want of a yearly cleaning out, or the "standing waste" pipe may deliver into the trap of a water-closet, or into a soil-pipe, or direct into the underground drain itself, and deliver foul air into the house, as well as cause a dangerous scum to settle on the drinking-water ready to be drawn off. In towns, especially in area vaults, a servants' water-closet is often supplied from the main of an intermittent supply, and flushed out only at the time when the turncock has laid the water on. Very frequently, too, it will be found that the closets are supplied direct from the only cistern in the house, and housemaid's, butler's pantry, scullery, and servants' hall sinks, and the kitchen boiler, all supplied from a roof cistern, which perhaps supplies four or five closets of a bad pattern. But should the patterns of the closets be good, it is a pernicious and dangerous system to supply closets from a drinking-water cistern, and the ingenuity expended in devising valves for closets which might prevent contamination is now beginning to be looked upon as having been spent in a useless direction. Many plumbers will argue the question for hours, but it would be safest to bear in mind that all closets should be connected with a cistern or cisterns supplying nothing but closets, urinals, or chamber-slop sinks. And where it is not convenient to provide a separate cistern for the closet, the inventors who have been working in the right direction, and not relying upon valves, have now produced a number of small iron disconnection cisterns with separate ball-cocks, the use of which above each closet disconnects the closet from any drinking-water cistern.

In examining houses, both in town and country, it is somewhat curious to notice how very often cisterns, supplying water of all kinds, are hidden away in roofs, and it is sometimes almost a break-neck expedition to obtain access to them ; and when one emerges from the den in which they have been hidden, he resembles a man who has been down a coal mine. Now a cistern should be in a cistern-room if possible, but, at all events, placed where it can be got at, covered over with suitable fittings, and ventilated to the open air if convenience offers. A drinking-water cistern should never be placed in a water-closet, although this is frequently to be seen, and no amount of disconnection in such a case will suffice to counteract its evil emplacement. Neither should it be placed in a bath-room, which is liable to a steam-laden atmosphere. Nothing can be said against a site out of doors, on the flats, or below (if away from dustbins and ash-heaps), but in such cases the cistern, with its service-pipes, should be well protected from frost. The position of a cistern should be equally carefully chosen, no matter whether the supply be constant or intermittent, or whether there be a high or a low pressure cistern. And not only should it be made certain that the "standing waste" pipe of the cistern delivers in the open air, but that any "overflow" pipe of the cistern delivers in like cleanly fashion. It is too common, even in new houses, to take these wastes down to the nearest sink. It might prove expedient to thus disconnect a cistern waste when time presses, and when the alternative is costly, but the practice is not to be commended.

These strictures with regard to cisterns apply equally to those "feed" cisterns which supply "hot water circulating cisterns," or boilers where water is heated for kitchen, scullery, still-room, or bath-room uses. It is too common to find the "feed cistern," which is the small iron cistern that automatically keeps the kitchen or other basement boiler full, placed in the darkest corner of the commonest stowaway cupboard, with its overflow pipe joined to the drain. On one occasion, in a large town house in the West of London, the servants complained that the hot water drawn from the tap at the kitchen jamb tasted badly, and was of the colour of weak tea, which was no wonder, for an exploration of the feed cistern in the cupboard led to the removal of several basins full of drowned black-beetles, in all stages of dismemberment.

CISTERN MATERIAL.

The materials of which cisterns are composed vary very much in town and country, and require a short notice. In old houses there will be very frequently found cisterns formed of slabs of stone, just as they have been raised from the quarry, and sometimes of slabs of rough slate, and than these, provided they are regularly cleaned out and the waste pipes disconnected, probably no better basement cistern could be found. The same might perhaps be said of those cisterns formed of brickwork and cemented inside, but the palm of merit would go to the cistern composed of cleanly slate.

Cisterns of sawn slate are now very common, and are very cleanly, and the only drawback they have is to be found in their weight, which sometimes prevents them from being adopted upstairs. Wherever they can be provided they should be chosen in preference to all other kinds of cisterns, and it has become a very frequent practice now to have them enamelled white inside, so that the slightest abnormal discoloration of the water, or sediment in the bottom, can be instantly detected.

Another class of cisterns are those which are composed of metal throughout. These may be old cisterns of cast lead, dated early in the 18th century, and hundreds of these can still be found, especially in London and its neighbourhood. The ancient cisterns are of wonderfully pure metal on account of their natural silver alloy, and they may be trusted, all other conditions being satisfactory. There is also the cast-iron cistern, which is generally made of plates bolted together, and if they are kept full, and not subject to rust, they are unobjectionable.

The next kind of cistern coming under this class is the wrought-iron cistern, which has afterwards been galvanised. This is a very common form of cistern, and appears to be the cheapest at hand. Nor can much be said in its disfavour, although experiments made in America have proved that some waters attack the inner coating.

The commonest form of cistern extant in houses will be found to be composed of wood framing lined inside with sheet lead. This is not the best cistern to select for storing drinking-water, and slate would be preferable, but no one would go so far as to say that water drawn from a leaden cistern would injuriously affect health, and that therefore all leaden drinking-water cisterns should be abolished. If the interior of a lead-lined cistern be examined, it will be found to have acquired a whitish coating, and it is to this chemical alteration of its surface that the contained water of such a cistern can be drunk with more or less impunity. Nevertheless, there are some waters which very readily attack lead, and care should be exercised in this respect.

In cleaning out a lead cistern the surface should never be scraped, but simply washed down with a moderately hard brush. Sometimes the builder, for the sake of cheapness, will provide a house with a zinc-lined wooden cistern, and this for several reasons is one of the worst materials for water storage, and should never be used for the holding of drinking-water. Neither should wooden butts or barrels be used for storing water anywhere in a house, as they speedily become lined with a low vegetable growth detrimental to health.

One of the greatest mistakes made in houses is the storing away of a great quantity of water in abnormally large cisterns, in consequence of which the tap is drawing off for a very long period the water first delivered to it, and, consequently, not the cleanest water. This might not so much matter in cisterns which supply closets or, say, the cold water for baths, but it is reprehensible when the water to be supplied is for the housemaid's sink tap whence is drawn the bedroom decanter water and the supply to the nursery. Where such large cisterns exist, especially if they are lined with lead, they should be reduced in size to suit the measured requirements of the house, but, as before explained, it is always best to fix a small slate cistern upstairs for the yield of drinking-water. The above remarks apply to all cisterns, whether the supply be of an intermittent or constant character.

The pipes used for the conveyance of water are generally of lead, because it is more easily bent than any other metal, but frequently iron pipes are substituted when the water main has to be brought from a great distance. There can be no doubt that the conveyance of some waters in long lengths of lead pipe, in which the water must necessarily stand, and the use of lead suction pipes in wells, is not a thing to be looked upon with great favour. Hence it is that galvanised-iron pipes are used by some, and in the case of water conveyance from a long distance, the cast-iron pipes coated inside with Dr. Angus Smith's solution, or subjected to the Bower-Barff system of protection against rust, are now very largely adopted. Glass-lined pipes of the American pattern have also been introduced into this country, but have not yet made much headway, which is a pity, seeing that glass forms the best of all conduits for water. As before mentioned, a great deal depends upon whether the water is of such an ultra-soft or other character as to rapidly decompose lead.

The above remarks would apply more particularly to the mains leading to cisterns, but there still remain a few words to be said respecting the service pipes which convey the water from the cistern to the various draw-off taps, and here what has been noticed respecting lead pipes might well be borne in mind. Lead pipes, of sufficient weight per lineal foot, might without cavil conduct the flushing water for closets and the cold water to baths and lavatories, but there is fortunately now to be obtained what is called the "lead encased block-tin pipe."

A section of this pipe is drawn at Fig. 43, and it will be seen that the inner ring of pure tin constitutes a distinct pipe from the outer casing of lead. Where all the recommendations of science can be adopted in a house, then this kind of service pipe should be used in conveying water from the separate drinking-water cistern to the traps whence drinking-water is drawn. The cost is some 50 per cent. more than for lead pipe, and there is more difficulty in making the joints, but these points are overbalanced by the feeling of security experienced with regard to the non-pollution of the water. There is another class of tin pipe, but the tin in the

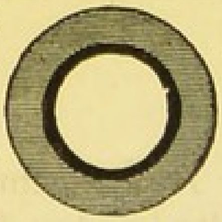


FIG. 43.

interior has merely the consistency of a film inside, and this is soon lost.

There are several things which might be mentioned with regard to water pipes, as affecting the comfort of the family, as, for instance, the placing of rising mains and services elsewhere than in close proximity to the soil-pipe, and in chases in the wall, close alongside and even touching the hot-water pipes, which is a frequent error; and everyone knows how disgusting it is to be treated to a tepid water instead of one perfectly cold when coldness is especially desired.

Water pipes should, as much as possible, be fixed in separate wall chases, easy of access. Service-pipes should also, as much as possible, be kept separate from each other, and provided with proper stopcocks in case of accident. In examining houses, one encounters most incongruous methods of supply, and as an example of this, I give at Fig. 44 an engraved photograph copy of a pipe, or rather bundle of pipes, in my possession, which proves fairly puzzling. No one could make out with certainty which was the original pipe, or find out the sequence in which the outlying pipes were added.

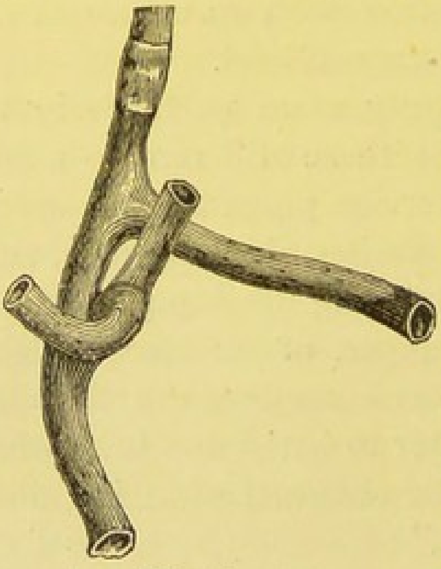


FIG. 44.

FILTERS.

A few remarks might be made upon the question of filtering, but it would be difficult, without a knowledge of the water, to say how far filtering will benefit it. Certainly filtering will not remove all traces of fresh sewage contamination. The chief use of a filter is to break up organic impurities, and render them harmless. Professor Wanklyn has proved that one kind of filter, in which a blood-red solution of the aniline dye magenta was, was able to produce a water perfectly free from colouring matter, and to filter out from the water which was poured in a large quantity of strychnine, and he came to the conclusion that this filter was capable of removing from water all forms of nitrogenous organic matter. As used in an ordinary house in the cistern, the filter is far too seldom cleaned out, whereas it should be cleaned out every three months, if it is to perform any work at all; no matter what kind of filtering media is used. The majority of scientists who make waters their chief study will, I think, be found to agree with Dr. Lane Notter, of Netley Hospital, in deprecating too implicit a reliance upon any kind of filtration. A case occurred in my practice a few years ago, where the butler was attacked with blood-poisoning and fever, and the noble owner of the house had the water supply from every drinking-water cistern examined, some six in number, and the only cistern found to yield contaminated water was that supplying the butler's pantry sink, and in which had lately been placed a large charcoal filter. It must be left to chemists to say what kind of filter is the best. Even to register what has been said concerning them is outside the pale of this Handbook. The hand filters should especially be regularly cleaned out, but unfortunately they are very often neglected.

HARD WATERS.

Some waters are excessively hard, some even permanently hard, and the water supplied by water companies in the chalk districts are always exceedingly hard, because it has not been softened by the addition of lime in proper tanks, so as to neutralise the excess of carbonic acid, and precipitate the carbonate of lime. The majority of hard waters fortunately become soft by being boiled, and it is fortunate for the small householder in the country that it is so. The hardness of water is commonly due to the presence of carbonate of lime, and boiling separates the carbonic acid gas, and deposits the fur or chalk on the interior of the kettle. In large country houses, where the water is very hard, it can be considerably softened by the use of the filter manufactured by Atkins & Son, Charing Cross. Where the requirement for soft water is in excess of what filtration will perform, such as would be requisite for a large country seat and surroundings, recourse might be had to the Clark or Porter-Clark process. The process should be seen to be properly understood, and the nearest place to London for doing this, is at the Colne Valley Water Company's Works, in Bushey Meadows, near Watford. The water which is pumped up from the chalk possesses eighteen degrees of hardness, and is finally discharged into the reservoirs at Bushey Heath, with a hardness of little more than three degrees.

CHAPTER VI.

CONCLUSION.

A FEW words by way of conclusion to this Handbook, which I have ventured to write throughout in an earnest and simple manner. The subjects treated of are really of too serious a character to be flippantly discussed by any periphrases of wit, although much might be achieved in this direction. What few paragraphs remain will be still more commonplace than those which have gone before, and will refer to some points which present themselves for consideration when a house, already built, is about to be purchased or leased, or taken either for a long or short period. When a house has to be built it is hoped that the conditions as to site, drainage, water-supply, and the like, which should control the erection, will be found sufficiently shadowed forth in the previous chapters.

Undoubtedly the initial approach to perfection in a house rests almost entirely with the architect, and I may add, in passing, that it has now become a practice for him to associate himself with an engineer in the construction of large new dwellings. The architect presides over the choice of site, the arrangement, construction, and ornamentation of the structure; and the engineer, when one is consulted—owing to certain moot points on sewerage, water-supply, and ventilation, upon which he is perhaps better able to decide—assists in these matters. But by this I do not mean to suggest that architects as a rule are not in every way competent to deal with the most abstruse questions relating to healthy-house building. Several of our eminent architects are very advanced sanitarians in all that pertains to the house proper. And if architects feel themselves deficient in any respect, it would appear to be in drainage disposal, or in the details of a complicated system of water supply.

In purchasing a house, or in renting one, it is the duty of the intending occupant to make sure that it fulfils all the requirements of a healthy habitation for his household. Experience has proved that it is absolutely necessary to examine the sanitary condition of a house before entering upon residence; and when this has not been done the probabilities are that the house will be found to be of an undesirable character. A house should, therefore, not be chosen hastily, notwithstanding that the estate agent may especially recommend it. His knowledge may not have led him to be cognizant of all which constitutes the health-worthiness of a dwelling. It may be also that he has been misled by an ignorant builder, although the difficulty nowadays is to discover one who does not lay claim to "sanitary engineering in all its branches." It is the duty of a house agent to let the house placed upon his books, and it is the duty of the house-seeker to make certain that the dwelling is in a satisfactory state of sanitation. It is here that the services of a skilled examiner of houses, whether architect, engineer, or surveyor, becomes most necessary—one who will examine everything for himself, and who will take nothing for granted at the word of owner, agent, or builder. It is lamentable to find how often a residence is taken for a short period only and has almost immediately to be abandoned, before even a week's tenure has expired. The difficulty with the professional man who inspects the house for the purpose of a short holding by his client is great and onerous, for, as a rule, not one house in fifty but transgresses the laws of health in respect of drainage and water supply.

No town house, however limited in time its projected occupancy may be, but should have its system of underground drains examined, so as to ascertain whether the drains are of brick or of glazed earthenware, and as to whether they are free from internal deposit or not. In the case of houses hired in the country the serious question of cesspools interposes itself, and must be efficiently met. The disconnection of the waste pipes, the ventilation of the drains and soil-pipes, the regulation of the closets and the severance from the drain of the cistern wastes, are matters which must perforce be adjusted before even a month's stay in a house by a client should be allowed by his adviser. The difficulty with the adviser is where to stop, for he is aware that the houses which he could declare fairly habitable, and which do not require something to be executed in the way of disconnection of wastes, drain ventilation, and amended cistern supply, are very few indeed. He is also perfectly well aware that a disconnection of the house drain from the street sewer is also of the greatest importance, but this might take much time to effect, and the exigencies of his client cannot brook delay. Moreover, there are few owners of a house who will consent to any re-arrangement of its drainage system whatsoever. The owner may also be travelling abroad, and the house-agent may have no discretionary power to order even a tithe of the absolutely necessary work to be executed. Thus the seeker after a house, in town especially, when his time is of consequence, is often driven battledore-fashion between house and house and agent and agent, until his anxiety to obtain even a tolerably healthy house is perfectly worn out, and he either takes the first house which pleases his eye, or takes up his quarters in an hotel.

There can be little doubt that an efficient system of compulsory house registration—after satisfying a competent inspector—must some day prevail, in towns especially, where domiciles are eagerly sought after during certain seasons of the year, either for business or pleasure. Meantime much might be done in this direction. At present the custom with many persons desirous of letting their tenements is to furnish their agents with a copy of any certificate which may have been granted to them in respect of the good sanitary condition of their houses. The house agents have in such a case no difficulty in obtaining a tenant, and they separately register all those houses which they know to have undergone the alterations necessary to ensure a certificate of health. There is thus an incentive for the owner of a house to enhance the selling or letting value of the house. Sometimes the agent will be entrusted with a receipted account for moneys paid in respect of certain sanitary work which has been executed in the house, but this for many reasons is a very unreliable kind of certification.

Equally fallacious would be any trust placed upon a paragraph in an advertisement setting forth that "the residence is perfectly healthy, having been rendered so at considerable expense." It may be perfectly true that much money has been expended in sanitary work, and yet the house may not have been benefited in many essential matters owing to a want of knowledge on the part of the contractors who executed the works.

It would be useless to attempt to enter here upon the legal aspect of house tenancy in any of its bearings, upon the respective duties of landlord and tenant, or upon the rights which each can justly exercise. It is sufficient to say that the law enables a tenant to leave a furnished house without any satisfaction of rent, provided the condition of the house has been represented as healthy when it is grossly otherwise. The cases of this kind which have come up for trial and judgment are not however numerous, but many decisions bearing upon the mutual rights of buyer and seller, lessor and lessee, and so on, will be found in the "Legal Reports" which appear monthly in the *Sanitary Record*, published by Smith, Elder & Co., London. It would not be wise to take a furnished house relying upon being able to leave it should smells begin to prevail and vermin make themselves manifest in basement and bedroom, for the law laid down as to the "degree of unfitness for habitation" which will legally release the tenant is a very nice one, and beyond the acumen of most lay minds. It should rest and does rest with the tenant for his own comfort's sake to make certain that a house is fairly habitable, and it is better to have an examination made before residing in it than to risk any encounter at law and the expense of moving elsewhere.

With respect to the taking of an unfurnished house it should first of all be examined from a structural as well as from a sanitary point of view, and no house should be taken on lease unless the landlord offers to satisfy any professional or other competent man that the house is unexceptionable in these respects. Especial agreements may be entered into as to the payment of a premium and other usual provision, but nothing should prevent the proposed lessee of a house from making certain that he is not liable for anything for which he has not covenanted to pay. My advice is never to take a house on a "repairing" lease if it can possibly be avoided.

APPENDIX.

WATER SUPPLY AND DISPOSAL OF SEWAGE OF COUNTRY HOUSES.

By Rogers Field, B.A., M. Inst. C.E.

THE principles which should regulate the water supply and drainage of a healthy house are identical, whether that house be situated in the town or in the country; but when we come to the application of these principles we find certain differences between town houses and country houses, and the points in which there is the most difference are treated of in this Appendix.

In the case of town houses there is usually a public water supply which is sufficient in quantity and fairly pure, and the chief point to be attended to is that the water should not be contaminated after delivery into the house. In the case of country houses, on the other hand, there is generally no public water supply, and special means have to be adopted to obtain water. It is therefore of the utmost importance to ensure that the water thus obtained is not only sufficient in quantity, but pure in quality.

Again, in the case of town houses, there is usually a public system of sewers, so that the chief points to be attended to are the arrangement of the pipes and drains in and around the house, and their connection with the public sewer. After the sewage has been removed from the house in a proper manner, and delivered into the public sewer, the duty of the householder ceases, the disposal of the sewage resting with the sanitary authority. In the case of country houses, on the other hand, there is very raraly a public system of sewers into which the house drains can discharge, and the disposal of the sewage must therefore be dealt with by the householder. The method of this disposal, moreover, has a serious bearing on the healthiness of the house.

WATER SUPPLY.—QUANTITY REQUIRED.

In providing a water supply for country houses, the first point to consider is the quantity of water required. The amount supplied to towns by waterworks is usually expressed in gallons per head of the population per day, and it will be convenient to adopt the same mode of computation for country houses—population in such case meaning, of course, the number of inmates. The quantity of water per head per day supplied to towns varies enormously in different cases. From a return which was made to Parliament in 1879 of the water supply to every urban sanitary district in England and Wales, it appears that the supply varies from 5 gallons per head per day to more than 50 gallons. The different towns range themselves fairly regularly between these limits, but there are a greater number at the lower end of the scale than at the upper end; and in the case of the majority of the towns with very small supplies, the supply is expressly stated to be sufficient. If, instead of taking entire towns, districts or portions of towns are taken, the variation is still greater, and a case is on record in which the supply to a considerable district was as much as 146 gallons per head per day.

We should, of course, expect a considerable variation in the quantity of water used in various towns on account of the different circumstances in which they are placed, and the different habits of the people. In some towns there are very few water-closets and baths, in others they are universal, and in others, again, a large amount of water is used for municipal and trade purposes, and so on. After making every allowance, however, for differences of this kind, they are not sufficient to account for the very great variation in the quantity of water consumed in different towns. The true explanation is, that a large proportion of the water supplied is in many cases simply wasted, and not used in any legitimate sense of the term.

As the question of waste has an important bearing on the water supply of country houses, it will be well to consider it a little further. The most instructive experience on the subject has been obtained in large towns which have a constant supply, so that the occupiers of the houses can draw as much water as they like directly from the public mains at any time of the day or night. In several such towns steps have been taken systematically to measure the water supplied to different streets and districts, and it has been found that, without restricting the supply in any way, the consumption of water has been immensely reduced, simply by sending inspectors to make a house-to-house visitation and search out and repair leaky pipes and defective taps and ball cocks. It is by no means an unusual thing for the consumption to be reduced one-half by inspections of this kind, showing that at least one-half of the water which was previously supplied to the houses was simply wasted through leaky fittings.

Many people are inclined to think that a waste of water of this kind is, after all, not a bad thing, as it must help to keep the drains flushed. This is quite a mistake. A small dribble of water from a leaky pipe or a leaky tap, though it will waste a great deal of water in the course of twenty-four hours, is perfectly useless for flushing the drains. What is wanted for this is the sudden discharge of a large quantity of water, as explained in Chapter III. The dribble of water from leaky pipes and taps does no good in any way, but simply wastes what might be usefully employed, and in many cases causes a supply to run short which would otherwise be ample for all legitimate uses. Another point that it is difficult to realise is the large quantity of water which will run to waste through what is apparently a very small leak. The quantity leaking looks so small in comparison with the quantity running when a tap is open, that one is inclined to think it perfectly insignificant, forgetting that the leakage goes on continuously night and day, whereas the tap is only open for a few minutes. In country houses, where it is often difficult to obtain a sufficient supply of water, it is particularly important to bear in mind the serious influence that leaky pipes and taps have on the consumption, and never to allow such leakage to go on for any length of time.

Although useless waste should be prevented, it is most important that the legitimate use of water should be encouraged in every way. As Dr. B. W. Richardson, F.R.S., has well pointed out, absolute cleanliness, properly understood, is the beginning and the end of sanitary design, and thorough cleanliness, of course, can never be obtained without an ample water supply. Not only should there be sufficient water for baths, lavatories, and washing of all kinds, but there should be a liberal allowance for flushing water-closets and all other sanitary appliances. Taking these sanitary considerations into account, as well as giving due weight to the observations which have been made by engineers and others on the quantity of water actually used in houses under different circumstances, it may be assumed that if waste is efficiently prevented a supply of from 20 to 25 gallons per head per day is sufficient in ordinary cases for houses with baths and water-closets. If horses are kept, a separate allowance should be made for them, and for stable purposes (a useful approximate rule being to reckon a horse as a man), and if water is used for watering gardens or ornamental purposes, this must also be reckoned separately. In large mansions a somewhat greater supply than 25 gallons a head may be required (exclusive of stables, gardens, &c.), but speaking generally, and omitting exceptional cases, any considerable increase beyond this quantity will imply more or less waste.

If earth-closets are adopted instead of water-closets, less water will be required, and from 15 to 20 gallons per head per day will be sufficient. In cottages with earth or other dry closets the quantity of water required will be still less. Ten gallons per day per head will be an ample supply, and even five or six gallons a head may do in cases where it is absolutely necessary to limit the quantity used. In many cottages much less than this quantity is used, but it cannot be considered a sufficient supply from a sanitary point of view.

SOURCES OF SUPPLY.

The water supply of country houses is, in the vast majority of cases, derived from springs or wells. Rain-water collected from roofs is very frequently used as an auxiliary, and occasionally as the main supply. There are, of course, instances in which the supply is taken from streams or rivers, and even some in which water running off the surface of the ground is collected in "impounding reservoirs" (a mode often adopted for the water supply of towns), but as these cases are exceptional, and therefore beyond the scope of this Appendix, we shall not further allude to them, but shall confine our attention to springs, wells, and roof-water.

RAINFALL.

The primary source of all water supply is rain, and springs and wells form no exception to this rule, though in their case the connection with the rainfall is by no means so clear at first sight as it is in the case of streams and open watercourses. We can see the rain which falls on the surface of the ground, and can follow it as it trickles along the watercourses and runs into the streams, and we can also see the effect of heavy rain in producing floods or freshets. All this is directly visible and familiar to us, whereas the passages by which the rain reaches springs or wells are not visible, and heavy rainfalls often have no apparent effect on their yield. Then, again, there are in various parts of the country curious intermittent springs (locally called bournes), which burst out in some years and not in others, and the connection between which and the rainfall is still more obscure. To explain these and other difficulties, various ingenious hypotheses were formerly suggested by scientific men as to the origin of springs, but it is now well established that all springs are nothing else than rain-water which has penetrated into the earth and finds its outlet at certain points that afford ready means of escape. This rain-water, before it issues from the ground as springs, accumulates in the porous strata beneath, and forms, as it were, large underground reservoirs, and it is from these reservoirs that wells, sunk into the porous strata, derive their supply.

As the rainfall plays such an important part in all water supply, it will be well briefly to consider how the rainfall is measured and what its amount is. The usual method of expressing the amount of rain is by the *depth* that has fallen on a flat surface, and this depth is generally measured in inches. For instance, when we say that one inch of rain has fallen during a certain time, we mean that if a tray with vertical sides had been placed on level ground to catch the rain, sufficient water would be caught to cover the bottom of the tray to the depth of one inch. The instruments by which rain is measured are called rain-gauges, and these are in principle nothing but trays, only the rain-water is not allowed to remain in the tray, but is conveyed by a funnel at the bottom of the tray into a bottle or other receptacle. In order to measure the rain, the water in the bottle is poured into a measuring-glass, the area of which bears a known ratio to the area of the tray.

The amount of rain varies enormously in different parts of the world, some districts being either absolutely rainless, or having only a very few inches of rain in the year, whereas others have some hundreds of inches in the year. Even in England itself there is considerable variation. The average rainfall for the whole country is about 30 inches a year, but the amount in different parts of the country varies from about 20 inches to nearly

200 inches a year. The eastern side of England has much less rain than the western side, and, roughly speaking, if a line be drawn from Portsmouth to Newcastle-on-Tyne, it will divide the country into a dry portion and a wet portion. The portion of the country on the east of this imaginary line will (with the exception of the south coast, which is wetter) have only 25 inches of rain or less, and the portion on the west of the line will have from 30 to 50 inches, with much larger amounts in the Cumberland and Welsh mountains, and at Dartmoor.

Not only does the rainfall vary in different districts, but in the same district it varies in different years. The figures quoted above refer to the average rainfall of a number of years, but if we compare the separate years amongst themselves we shall find that the rainfall of the wettest year is about double that of the driest year. This gives a very useful rule for roughly ascertaining the rainfalls of the wettest and that of the driest years, which are really more useful for the purpose of water supply than the rainfall for an average year. The fall in the driest year may be assumed to be one-third less than the average fall, and the fall for the wettest year one-third more. Thus, with an average rainfall of 30 inches, the fall of the driest year would be 20 inches, and that of the wettest year 40 inches.

UNDERGROUND WATER.

Only a portion of the total rain which falls is available for water supply, as there is always more or less loss. In the case of rain falling on the roofs of houses the loss is comparatively small, but in the case of rain falling on the surface of the earth the loss is considerable. The rain which falls on the earth is disposed of in three different ways: part of it runs directly into open watercourses and streams, part is taken up by vegetation or lost by evaporation, and part sinks into the ground and accumulates in the water-bearing strata which feed the springs and wells. It is only this latter portion, viz., that which sinks into the ground, that I at present propose to deal with.

Observations have been made on the amount of the percolation in different cases, and it has been found to vary very greatly. The observations also show that the amount of percolation does not depend so much on the amount of the rain as on the conditions under which the rain falls. By far the greater portion of the percolation takes place in winter and comparatively little in summer, the reason being not that the rainfall is more in winter than in summer, but that the conditions are more favourable for percolation. In winter the ground is wet, evaporation small, and vegetation inactive, so that a large proportion of the rain sinks into the ground; whereas in summer the ground is dry, evaporation large, and vegetation very active, so that most of the rain is taken up before it can percolate. So great is the difference between summer and winter as regards percolation, that one may generally leave the summer rainfall altogether out of consideration, and assume that it depends on the amount of rain which falls during the six months from October to March, whether the underground store of water will be fully replenished or not.

The rain which penetrates into the ground accumulates, as already stated, in the porous, water-bearing strata, and forms large underground reservoirs, which feed the springs and wells. The height of this underground water is indicated by the level at which water stands in wells, and it is found that this height varies considerably at different seasons of the year. Observations show, moreover, that these variations usually follow a regular course: the water is generally lowest in the wells in October and November, it then rises rapidly for three or four months, till it reaches its highest point in February or March, and after this it falls slowly for eight or nine months till the following autumn, when the cycle is repeated.

This cycle exactly accords with what we should expect from the facts previously stated about percolation. The large amount of percolation which takes place in winter rapidly fills the underground reservoir, and this causes the water to rise. In the spring the percolation reduces in amount, and in the summer it is almost nothing, consequently the supply to the underground reservoir gradually falls off. All this time, however, there is a constant draught from the reservoir by the springs and other outlets, and the underground water therefore gradually falls till the winter, when the percolation is again sufficient to replenish the reservoir. Occasionally the rise and fall of the underground water does not altogether follow the ordinary cycle, and it will then be found that there has been something very exceptional in the rainfall. For instance, in the year 1879 the water in many of the deep wells in the chalk in the south of England rose in the middle of the summer, and obtained a maximum height in August, but this is fully explained by the fact that the summer of this year was exceptionally wet (in fact one of the wettest on record), so that the ground was thoroughly saturated, and a large amount of percolation took place.

The variation which takes place in the height of the underground water between autumn and winter may be called the "seasonal variation." In sinking wells it is of great importance to know the amount of this variation, as, unless the bottom of the well is sunk below the lowest level to which the water falls, the well will run dry. The seasonal variation is very different in different cases. In the upper districts of the chalk it is 50 to 100 feet or more, whereas in the lower districts it is a few feet only. In order to understand the reason of this great difference we must consider the movement which takes place in underground water.

In speaking of the accumulation of water in the ground, I have called it, for want of a better term, an underground reservoir, but this is not a strictly accurate description. By a reservoir we should generally understand a large body of water at rest, and with its surface perfectly level, whereas the underground water is continually, though very slowly, moving, and its surface has a well-defined inclination. The real state of affairs will be better understood from Fig. No. 45, which represents a section through the Chiltern Hills, taken from a series of valuable geological sections of the Thames Basin, prepared by Professor Prestwich, F.R.S. The section commences at the River Thames, near Wallingford (A); passes through the Chiltern Hills, and crosses the River Thames again at a point (F), a few miles below Henley-on-Thames. The distance between the points A and F in a direct line is less than eleven miles, but the distance by the river is considerably more than twice as much, as the river makes an enormous horseshoe bend. A certain portion of the rain which falls on the Chiltern Hills sinks into the chalk, and passes downwards until it is arrested by the impermeable Gault clay. The water then

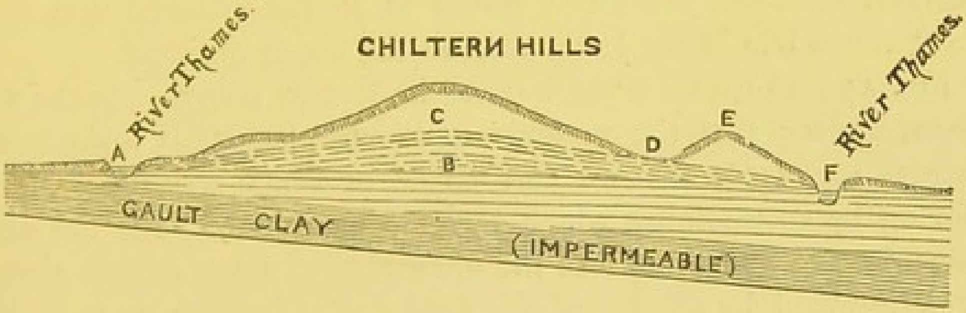


FIG. 45.

accumulates in the chalk, and renders this permanently waterlogged up to the line A B F, the position of which is governed by the lowest points of natural escape, A and F.

This line A B F represents the lowest level to which the underground water ever falls, and as soon as the winter percolation takes place the water begins to rise above the line A B F. Inasmuch, however, as the level of the outlets into the Thames at A and F are nearly constant, the rise of the underground water is comparatively slight near A and F, and gradually increases as the distance from these outlets increases, till at the point C it reaches its maximum. The various dotted lines that are shown between B and C represent the various heights to which the underground water rises at different times, the highest of these lines, A C D F, being the highest water-level ever reached. The height of C above B therefore represents the maximum amount of what has been called "the seasonal variation" in the height of the underground water at the centre of the Chiltern Hills. In the same way the amount of the seasonal variation at any other point is represented by the height of the lines A C D F, above the line A B F at that point, and it will be seen this height becomes less and less the nearer we approach the outlets at A and F. This explains what was previously stated as to the seasonal variations being much less in the lower than in the upper districts.

Fig. 45 also explains some other important points. In the first place, we see that the underground water has a fall towards the nearest outlet, so that we can judge of which way the water is moving by ascertaining which way the water falls. In the next place, we see that the fall of the underground water cannot always be determined by the fall of the land. The land between E and D falls from right to left, but the underground water falls the contrary way. Lastly, the section affords a good illustration of the intermittent springs, or "bournes," previously alluded to, and of the cause of a spring generally.

SPRINGS.

At the point D, on Fig. 45, there is a spring which only "breaks" or flows occasionally at irregular intervals, often of several years, and when it does flow usually commences about December or January, and ceases to flow in the summer. On looking at the Figure, it will be seen that at this very point D there is such a deep valley that, when the underground water rises to its greatest height, it is above the ground. The consequence naturally is that, under these circumstances, this valley forms an outlet for the water, which then issues from the chalk and forms the Assendon Spring. When, on the other hand, as is the case in many years, the water does not rise as high as the bottom of the valley, the spring will not flow. The times of year at which the spring usually "breaks" also agree with what we have previously seen as to the times of the rise of the underground water.

Ordinary springs are to be explained very much in the same way as Assendon Spring, the chief difference being, that in ordinary springs the outlet is usually low enough to allow the underground water to escape during the whole of the year, instead of only now and then. Referring again to Fig. 45, although the greater quantity of the water from the Chiltern Hills escapes directly into the bed of the River Thames, there are also large springs near A and F which run continuously during summer and winter. These springs are what would be called main springs, as distinguished from land springs, which are springs arising from superficial beds of drift or gravel lying on impervious strata. Land springs are much more irregular in their flow than deep seated main springs, and sometimes fail altogether in dry seasons. Main springs, though comparatively constant, generally have a regular seasonal variation in their flow corresponding with the seasonal variation in the rise of all of the underground water, and yield least in autumn and most early in the year.

In selecting a spring for the supply of a country house it is most important to bear in mind the seasonal variation. A spring which may give an ample quantity of water in the winter may give an insufficient quantity in the autumn, so that the measurement of a spring in winter should never be depended on for determining whether it will do as a source of water supply. The only safe way is to wait till the autumn yield of the spring has been ascertained, and even then an allowance must be made for the previous winter, as, if it has been a very wet one, the yield of the spring will be abnormally high.

WELLS.

We now come to the question of wells. They are usually divided into shallow wells and deep wells, the distinction between which, though not very clearly defined, is much the same as that between land springs and main springs. Deep wells are almost always preferable for a water supply to shallow wells, but as there are many cases in which shallow wells are the only ones practically available for country houses, it will be advisable to consider somewhat carefully the conditions which render them objectionable, so as to be able to avoid these conditions when sinking a well.

SHALLOW WELLS AND CESSPOOLS.

The great danger in the case of shallow wells is their liability to pollution, and the most frequent causes of pollution are drains, privies or cesspools, especially the latter. The question of the pollution of underground water by cesspools was very ably dealt with by Professor Prestwich, F.R.S., some years ago in his Presidential Address to the Geological Society, and I cannot do better than give a quotation from this address. After explaining how dry wells in porous strata will absorb liquids, he said :—

"So convenient and ready a means of getting rid of all refuse liquids was not neglected. Whilst on one side of the house a well was sunk to the ground springs at a depth, say, of 20 feet, on the other side a dry well was sunk to a depth of 10 feet, and this was made the receptacle of house refuse and sewage. The sand or gravel acting as a filter, the minor solid matter remained in the dry well, while the major liquid portion passed through the permeable stratum and went to feed the underlying springs. What was done in one house was done in the many, and what was done by our rude ancestors centuries back has continued to be the practice of their more cultivated descendants to the present day. . . .

"Instances occur from time to time to point out isolated consequences of this pernicious practice, but I believe no one who has not gone into the geological question can realise its magnitude. It is not confined to one district, or to a few towns or villages. It is the rule, and only within the last few years have there been any exceptions. The organised supply of water now furnished by companies in all large towns has, to a great extent, done away with the evil in those situations (though the root of the mischief has too often been left unextracted), but in villages and detached houses, great or small, it remains untouched and unchecked. Not a county, not a district, not a valley, not the smallest tract of permeable strata, is free from this plague spot. It haunts the land, and is the more dangerous from its unseen, hidden, and too often unsuspected existence. Bright as the water often is, without objectionable taste or smell, it passes without suspicion until corrupted beyond the possibility of concealment by its evil companionship. Damage slight in extent, or unimportant possibly for short use, but accumulative by constant use, may, and does, I believe, pass unnoticed and unregarded for years. Nevertheless, the draught under some conditions is as certain in its effect, however slow in its operation, as would be a dose of hemlock. Go where we may, we never know when the poisoned chalice may be presented to our lips. The evil is self-generating, for the geological conditions supplying our necessities lend themselves to its maintenance and extension. The knowledge necessary to remedy it is of very slow growth, and the too frequent want of that knowledge or disregard of the subject, even amongst able architects and builders, is such, that without legislative enactments I do not see how the evil is to be eradicated for many a long term of years."

Since the above was written fourteen years have elapsed, but Professor Prestwich's remarks are as applicable now as they were then. Some improvement has taken place, but it is only slight, and in houses in the country it is still considered as a matter of course that the way to dispose of the sewage is to construct cesspools or dumb wells, which in porous strata almost always allow their liquid filth to percolate into the subsoil.

The question will naturally occur, how is it, if this proceeding is really so dangerous, that it is so universally adopted, even by educated men? The reasons of this are not very far to seek, in fact are referred to in Professor Prestwich's remarks. In the first place, this subject is a disagreeable one, and the arrangements for getting rid of the sewage are generally kept out of sight as much as possible, so that it rarely occurs to any one to inquire what the arrangements are. In the next place, the water of contaminated wells is often so bright and sparkling, and free from objectionable taste, and the damage from the use of the water is apparently so slight, that people cannot believe that the contamination is of any importance. Lastly it requires a consideration of the question from the geological point of view, in order fully to realise the magnitude of the evil. This latter reason is perhaps the most important of all, and I will therefore go into it a little further.

The general idea as to the way in which wells are polluted by cesspools is that the foul matter passes directly from the cesspool into the well, and diagrams are often drawn in which the cesspool and the well are placed side by side, and a black stream of filth is shown running from the cesspool through the sides of the well. Now, though unfortunately gross cases of pollution of this kind do occur much oftener than any one who has not practically investigated the question could possibly imagine, yet this is not the way in which pollution most frequently takes place in ordinary country houses, and people therefore naturally jump to the conclusion that the evil is exaggerated. In the case of leaky drains passing near a well there is very often a direct passage of the sewage into the well, but in the case of cesspools, the way in which the contamination usually takes place is by no means so apparent and much more insidious, as will be better understood by reference to Fig. 46. This figure represents a section of gravel or other permeable strata, AA, underlaid by an impermeable stratum, BB. As already explained, a certain portion of the rain which falls on the surface will percolate downwards through the gravel AA, until arrested by the impermeable stratum BB, when it will accumulate in the gravel, and rise to a certain level, CC. If a well, D, be sunk in the gravel to a point below the level of this underground water, the water will flow into the well until it reaches the level, CC, and if water is pumped out of the well it will be replenished from the surrounding store in the gravel. If, on the other hand, a porous cesspool, E, be sunk into the gravel but not carried down as deep as CC, no water will flow into it from the gravel, and it will remain dry. If, now, water or sewage be poured into the cesspool, the liquid will not remain in the cesspool, but will leak out of it, and percolate

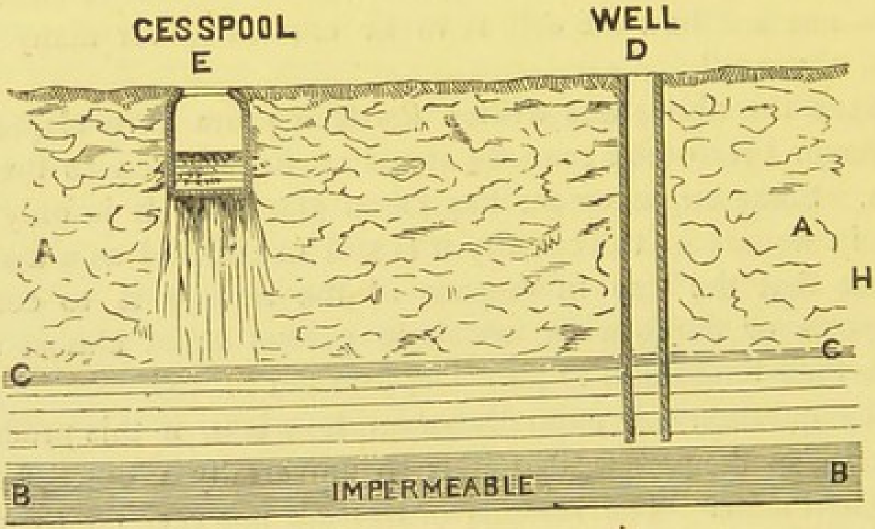


FIG. 46.

downwards like the rainfall to the underground water, CC, with which it becomes mixed. What takes place, therefore, is not a direct passage of the sewage from the cesspool to the well, but a contamination of the underground store of water from which the well draws its supply.

In villages or groups of houses cesspools and wells are frequently so intermixed that the entire bed of water is polluted, and hence all the wells are unsafe. Dr. Frankland, F.R.S., states that out of 420 samples of water which he analysed from shallow wells in rural hamlets and villages in different parts of the country, there were only 43 which were not highly polluted with sewage. In isolated houses, on the other hand, the case is different, and if the well and the cesspool are some distance apart, whether the well is polluted or not will depend chiefly on the direction of the movement of the underground water. If this movement is from the cesspool, E, towards the well, D, the polluted water will flow towards the well, whereas if the movement is in the contrary direction, the polluted water will flow away from the well. In the former case, the well will be fed by the underground water which has been contaminated by the percolation from the cesspool; in the latter case the well will be fed by the pure underground water flowing from H.

From what has been stated it will be seen that before sinking a shallow well where there are cesspools or other sources of contamination in the neighbourhood, the direction of the flow of the underground water should always be carefully ascertained and considered with reference to the position of such cesspool. It will, moreover, as previously explained, not be safe to assume that this flow is in the direction of the fall of the land, though it very frequently is so. The circumstances which affect the underground flow must be carefully examined, and if there is the slightest doubt, levels must be taken of the underground water in different places.

Shallow wells are also liable to contamination from surface soakage, especially in times of heavy rain, which washes refuse matter from the surface directly into the well. This can frequently be prevented by raising the top of the well above the adjoining ground, and paving the surface round the well with a slope from the well, so that the rain-water runs away from it. If, as often happens, the surface pollution soaks into the well laterally through the ground, the upper portion of the well should be made watertight, by excavating behind the brick lining and filling in with concrete or puddle to a sufficient depth to keep out the soakage. The Norton or Abyssinian Tube wells, which consist of an iron tube driven into the ground and surmounted by a pump, are useful for excluding surface pollution. There is, however, always a certain amount of risk involved in sinking a well amongst sources of pollution, however insignificant they may appear to be, and if the pollution is sufficient to contaminate the subsoil and reach the underground water, no precautions that can be taken in constructing the well will keep the pollution out. A striking example of this is given on p. 261.

CONTAMINATION OF DEEP WELLS.

Deep wells are often considered safe from contamination, but this is by no means the case. They are undoubtedly much safer than shallow wells, but still, under certain circumstances, may be polluted. A striking instance of this took place some ten years ago in one of the deep wells sunk in the new red sandstone formation for the supply of Liverpool. There were a number of houses in the neighbourhood which had private wells of their own, and the effect of the pumping by the powerful steam engines used in the new deep well was to dry these private wells. The householders then, in many cases, converted their wells into cesspools, and the result was that the water in the new deep well became polluted and had to be disused. This pollution, however, only took place very gradually, and it was five years after the deep well was constructed before the pollution was sufficient to cause the well to be disused. The sequel of the story is even more instructive than the beginning. A complete system of sewerage was carried out for the neighbourhood, the sewage was diverted from the cesspools, and in a little more than a year's time the quality of the water had so improved that it was safe to resume pumping.

The above case throws some light on a question that often arises in country houses, viz., whether a well which has been polluted by a cesspool will become fit for use after the cesspool has been removed. No general rule can be laid down which will determine this with certainty. If the work of removing the sources of pollution has been thoroughly done the well will frequently recover its purity, but if circumstances prevent the thorough removal of the filth the well may remain impure. A very instructive instance of both these conditions occurred in my own practice.

A large country house was supplied by a well about 30 feet deep, sunk in a gravel subsoil, and surrounded on two sides by leaky drains. The water of the well, when analysed, was pronounced to show signs of contamination, but still not to be sufficiently polluted to be unfit for use, and I therefore hoped that when the source of pollution had been removed the well would improve. The old drains and surrounding foul earth were entirely cleared away, and a new system of watertight drains constructed. The water was then analysed again, but, to my great disappointment, it was pronounced to have considerably deteriorated, and to be now quite unfit for use. I thought it possible that, as the previous month had been exceedingly wet, the deterioration might be due to a large amount of polluting matter having been washed into the subsoil when the ground was disturbed for removing the old drains, and it was therefore arranged that the well should be continuously pumped, and the water analysed every week. The result was most satisfactory. The first week there was a very great improvement, and the second week the water was pronounced to be quite fit for drinking. In another well on the same property, which was sunk partly under the outer wall of a slaughterhouse, a similar proceeding was adopted, but the result was not so satisfactory. The greatest precautions were taken to remove the source of pollution. The floor of the slaughterhouse was entirely taken up, the foul earth removed, and a new floor constructed of concrete. All old drains were taken up, and new watertight drains constructed. The upper 10 feet of the brickwork of the well was taken down and built in cement, so as to be watertight, with a view to prevent contamination by surface percolation. Notwithstanding these precautions, the subsoil had become so saturated with the soakage from the slaughterhouse that the well did not recover its purity after two weeks' pumping, and as the water was not much wanted, we did not carry the experiment on any longer.

Another question which frequently arises is, what is the least distance at which a well can safely be placed from a cesspool or other source of pollution. The answers which have been given to this question vary considerably. In the bye-laws made by local sanitary authorities for the drainage of houses, there is usually a clause prohibiting a cesspool being constructed nearer to a well than a certain specified distance, and this distance is generally fixed (with the approval of the Local Government Board in London) at from 20 to 30 yards. Dr. Frankland, F.R.S., on the other hand, states* that "the well should be at a distance of not less than 200 yards from the nearest house or drain, or cesspool, or other source of sewage pollution."

Bearing on this point, there is a very remarkable case quoted by Dr. Frankland, which occurred at the village of Lausen, in Switzerland, where the poison of typhoid fever was carried under ground for a distance of nearly a mile. There, however, it was a question, not of a well, but of a spring, and this spring had a direct underground communication with the source of pollution. The case occurred in this way; there was an isolated farm-house upon one side of a mountain ridge, and on the other side of the ridge there was a spring, which supplied almost the whole of the village of Lausen with water, only a very few houses having wells of their own. A farmer came home to the isolated farm-house suffering from typhoid fever, and his evacuations found their way into a stream passing by the farm-house. This stream was used at certain seasons for irrigating some meadows situated on porous ground below the house, and shortly after the infected water was turned on to this porous ground the outbreak of fever at Lausen commenced.

It had been suspected for a long time that this stream communicated with the spring at Lausen. Ten years previously a hole had been formed below the farm-house by the ground falling in, without any apparent reason, and on the stream being diverted, out of curiosity, into this hole, the water immediately disappeared, and an hour or two afterwards the spring at Lausen greatly increased in volume, the water being at first turbid, and afterwards becoming clear. It was subsequently noticed that when the stream was used for irrigating the meadows below the farm, the spring at Lausen began to flow more copiously. When the outbreak of fever occurred in the village, the question of the connection of the spring with the stream was carefully investigated. The hole above alluded to was reopened, and the entire stream diverted into it, and three hours after the spring at Lausen gave double the quantity of water. A large quantity of salt was then dissolved in the stream, and sent down with the water through the hole, and after two or three hours traces of the salt were detected in the spring at Lausen. Lastly, several hundred-weights of flour were mixed with the stream, and passed into the hole, but not a trace of turbidity was perceptible in the spring, showing that the fissures through which the water filtered were fine enough to prevent the passage of coarse particles. Nevertheless, there can be no reasonable doubt that the typhoid poison came through these fissures into the spring, because none of the people who drank water from the shallow wells in Lausen were affected by the fever, whilst only very few houses escaped amongst those which obtained their supply from the spring.

---

* Evidence before Select Committee of House of Commons on Public Health Amendment Bill, 1878.

Effects of Pumping.

When considerable quantities of water are pumped from a well, a new condition is introduced, which may have an important bearing on the question of pollution. To understand this we must consider for a moment what takes place when water is pumped from a well. In the first place, the water in the well itself is lowered; this affects the water in the porous strata immediately around the well, causing it to run into the well, and consequently to sink, and lastly the underground water at some distance from the well is affected, and gradually drawn towards the well. The well thus forms the centre of a funnel-shaped depression in the underground water, something similar to the depression which is often formed on the surface of the water in a fixed lavatory basin when the plug is withdrawn. The depth of this depression in the underground water, and the distance to which it extends around the well, will increase with the quantity of water pumped from the well. It will therefore readily be seen that a well which may be quite safe from pollution when only a small quantity of water is drawn from it, may be unsafe when large quantities are pumped, as in the latter case the sphere of its influence will be largely extended. For instance, there may be a cesspool so situated that the flow of the underground water carries the pollution away from the well so as not to affect the supply to the well under ordinary circumstances; but when continuous pumping is carried on, the water polluted by this cesspool may be drawn back to the well.

From what has been stated, it is evidently of considerable importance to know the form taken by the depression in the underground water, as this will determine the distance to which the influence of the pumping extends. There has been a good deal of misconception about this in England. The depression is usually represented as an inverted cone with straight sides, like a funnel, and it is sometimes stated that the influence of a well only extends to a distance equal to its depth. This is altogether wrong. The question has been very thoroughly investigated on the Continent, and it has been conclusively shown, both from theoretical considerations and by actual measurement, that the slope of the water towards the well assumes a curved form, so that the depression exists a long distance from the well. This will be better understood from Fig. 47, which represents a section of a permeable stratum in which a well, A B, is sunk. When the underground water is undisturbed by pumping it rises to the line C D E F, which, in this case, is horizontal, as the section is supposed to be taken across the fall of the underground water. When a moderate amount of pumping is carried on the water in the well is lowered to K, and the water in the ground takes the curved form represented by the line K D, K E. If there is continuous and severe pumping the water in the well will sink to B, and the water in the ground takes the curved form represented by the line B G C, B H F. These curves, it should be mentioned, are in reality much flatter and extend much further from the well than shown on the figure, as the horizontal scale has been purposely compressed in order to bring the diagram within a moderate compass.

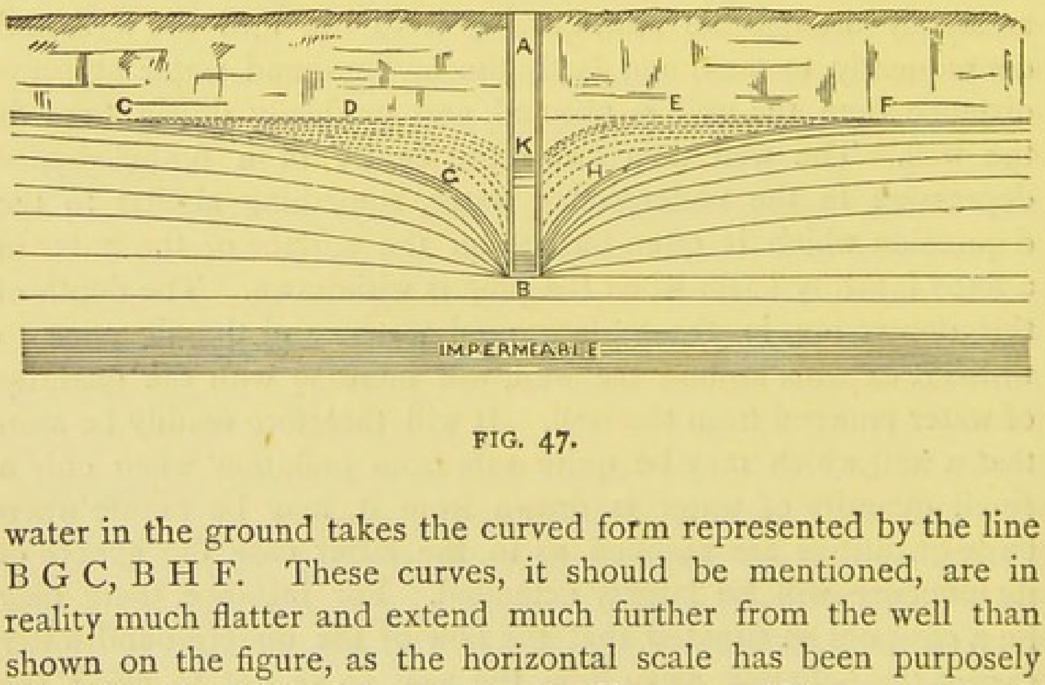


FIG. 47.

It will be seen from the figure that what chiefly governs the distance to which the influence of pumping extends is the depth the water is lowered in the well. In the case of moderate pumping, when the water is only lowered to K, the influence of the pumping only extends to D and E, whereas in the case of severe pumping, when the water is lowered to B, the influence extends to C and F. From this it would seem that we ought to be able to determine the distance a well drains if we know the depression due to pumping. The nature of the permeable strata in which the well is sunk has, however, such a great influence on the result, in consequence of the increased or diminished resistance that the ground opposes to the passage of the water, that in the present state of our knowledge we are not able to give any general rule on the subject. An investigation of various cases in which the distance has been ascertained appears to show that under ordinary circumstances it varies from 20 times to 100 times the depression or more; that is to say that if the water in the well is depressed 5 feet by pumping, the distance from the well to which the effect of this pumping extends may vary from 100 feet to 500 feet or more.

In all country houses of any considerable size, having proper arrangements for water-supply, the water is generally pumped from the well into an elevated tank, which is filled probably only once a day, and the pumping, as long as it lasts, is at a fairly rapid rate, especially if an engine of any kind is employed. Under such circumstances, it is not an unusual thing for the pumping to depress the water in the well as much as 5 feet, so that we must be prepared for the influence of the pumping extending to a distance of from 100 to 500 feet from the well.

RAIN-WATER FROM ROOFS.

We now come to the third source of supply, viz., rain-water from roofs. In the sixth report of the Rivers Pollution Commissioners, rain-water is classed amongst the "suspicious" waters, and is declared to be always more or less polluted with organic matter. This opinion has, however, not been generally indorsed by scientific men. It is admitted that in towns rain-water is seriously contaminated, but as regards rural districts, the consensus of opinion is that the contamination is so insignificant that rain-water, when carefully collected and stored, will afford a very wholesome supply. The real objection to rain-water from roofs as a supply for country houses, is with reference to quantity, not quality. It forms an excellent auxiliary supply, but where closets and baths are used the roof-water is very seldom sufficient for the entire supply of houses. Where earth-closets are used, the case is different, but even then it is only under favourable circumstances that the roof-water is really sufficient in the driest years, though it can be frequently made to suffice by limiting the quantity used. Let me illustrate this by two examples.

We will first take a very favourable case, viz., a large country house in the west of England, having only fifteen occupants, including visitors and servants, and with a roof covering an area of 7000 square feet. The average rainfall may be assumed to be 36 inches, and the fall in the driest year (see p. 251) 24 inches. The whole of even this smaller quantity will however not be collected, as a portion will always be lost by evaporation, splashing off the edges of the roof gutters, &c. With tile roofs the loss may be as much as 20 per cent., as tiles absorb a certain amount of the rain, but with slate roofs it will be less, probably about 10 per cent. As we are dealing with a wet district, we will take the loss at only 2 inches, which will reduce the available depth of rain in a very dry year to 22 inches. A depth of 22 inches of rain, on 7000 square feet, gives 80,000 gallons per annum, or 219 gallons a day, which, for the fifteen occupants, is equivalent to 14½ gallons a head per day.

We will next take a small house in the east of England, say 1200 square feet roof-area, with five occupants; the average rainfall will be about 24 inches, and the minimum rainfall about 16 inches; taking the loss as 2 inches as before, we shall find that the amount collected in a very dry year will be only 8700 gallons per annum, or 24 gallons a day, which, for five people, gives rather less than 5 gallons a head per day.

On referring to what was said (on p. 249) with reference to the quantity of water required in different cases, it will be seen that the amount of 14½ gallons per head per day available in the first example (the house in the West of England), is only just sufficient for a satisfactory supply; and that the amount of 5 gallons per head per day available in the second example (the house in the east of England) is not sufficient for a country house, but will only do for cottages, or cases where it is absolutely necessary to limit the quantity used. As the greater part of England has an average rainfall of less than 36 inches, and many country houses a less roof-area in proportion to their number of occupants than that in the first example, it is clear that roof-water cannot generally be depended upon as sufficient for the entire supply of a country house.

As an auxiliary supply, however, especially when the main supply is "hard," rain-water from roofs is most useful, and I will therefore give some further particulars with reference to it. The method of calculating the available supply will be evident from the example that has been given, but if an approximate result only is required, there is a very simple rule by which it can be immediately obtained. If the area covered by the roof in square feet be multiplied by the average annual rainfall, also in feet, and the result be divided by 100, it will give the average supply in gallons per diem that may be depended on in a very dry year. Applying this rule to the examples already given, we have in the first case, area covered by roof, 7000 square feet, multiplied by average annual rainfall, 3 feet, equals 21,000, which divided by 100 gives 210 gallons. This it will be seen nearly agrees with 219 gallons, the daily quantity previously calculated. In the second example; area covered by 1200 square feet, multiplied by average rainfall, 2 feet, equals 2400, which divided by 100 gives 24 gallons. This is identical with the quantity previously calculated.

In order to provide for a constant supply in dry seasons, it is absolutely essential that there should be a tank of sufficient capacity to tide over the longest drought, and the necessary size should always be carefully calculated in each case. In determining the size of reservoirs for impounding water from gathering grounds for the supply of towns, it is usual to reckon by the number of days' supply which the reservoir ought to hold, in order to tide over the longest drought, and rules have been laid down as to how many days' supply should be provided for different parts of the country. These rules, however, are not applicable to the collection of water from roofs, as the amount of evaporation in this case is so much less than in the case of gathering grounds, and summer rain, which would not send a drop of water into an impounding reservoir, would contribute a considerable quantity from a roof. The simplest way is to calculate the capacity required for the tank from the area covered by the roof, and it has been found by practical experience that the tank ought to contain at least 2 gallons for every square foot of roof area. This practical rule is confirmed in another way. A comparison of the driest months in a number of long records of rainfall in different parts of the country shows that, in order to tide over the dry period, at least 4 inches of rainfall ought to be stored in the east of England, and from 5 to 6 inches or more in the west of England. This is equivalent to rather over 2 gallons per square foot of roof-area for the east of England, and from 2½ to 3 gallons or more for the west of England. Applying these rules to the examples previously given, we find that in the first case (in the west of England) the tank should contain about 18,000 gallons, and in the second case (in the east of England) about 2500 gallons.

Rain-water tanks of large capacity for storage must generally be constructed underground, and the greatest care should therefore be taken to make them watertight, not only for the purpose of preventing the rain-water leaking away, but to prevent the infiltration of polluting matter from outside. The overflow pipe must not join directly to any sewage drain; the best way is, if possible, to make it discharge into an open ditch or on the surface of the ground.

Another point of importance is to prevent leaves, soot, and other refuse off the roof from entering the storage-tank.

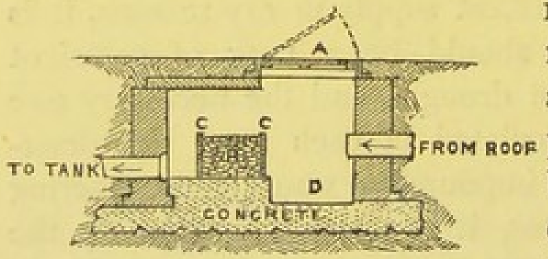
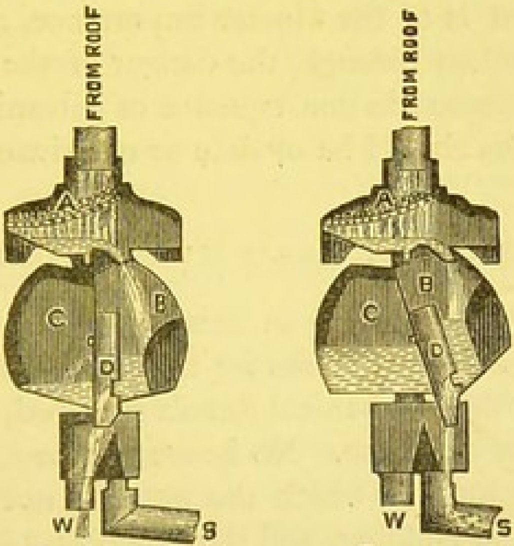


FIG. 48.

The simplest way of effecting this is to have a rough filter constructed, through which the rain-water passes before running into the tank. Fig. 48 shows a filter of this kind. It consists of a small brick chamber covered partly by flagstones and partly by an iron door, A, for facility of access. The filter, B, consists of fine, well-washed stones about the size of peas or nuts, contained between two movable partitions, C C, formed of slate perforated with half-inch holes close together. A small depression, D, is made in the floor of the chamber, under the inlet drain, for the purpose of collecting leaves, soot, &c. This depression will intercept the greater part of the refuse, and should be frequently cleaned out. The gravel filter will only require cleaning at long intervals. This can be effected by lifting out the slate strainers, removing the gravel, washing it, and then replacing as before.

Another way of preventing rubbish entering the tank is by means of an ingenious apparatus called Roberts' Rain-Water Separator, a sketch of which is given in Fig. 49. The principle of the action of this apparatus is to reject the first portion of the rain which falls (as it is this which chiefly washes the dirt off the roof), and only to collect the later portion of the rain. The water from the roof first runs on to the strainer, A (which intercepts rubbish), and then passes into the receptacle, B C, which is divided into two compartments, and balanced on a pivot so that it can tip to one side. In the figure, marked Position 1, the receptacle is shown in the position it takes at the commencement of a fall of rain, and the water, it will be noticed, is running out of the compartment, B, through two small holes, a lower one and an upper one. From the lower hole the water passes through the discharge pipe, D, into the pipe, W, which allows it to run to waste. This hole is so regulated in size that it takes some time for the water in the compartment, B, to rise to the upper hole (which is connected with B behind the discharge pipe, D). As soon as the water reaches the upper hole it begins to run into the compartment, C, and after this compartment is filled to a certain height the receptacle overbalances and tips to one side, so as to take the position shown in the figure, marked Position 2. The water then, instead of running to waste, is directed into the pipe, S, which leads to the large storage tank. The time which elapses after the rain has commenced, before the receptacle tips and sends the water to storage, is regulated by the size of the lower hole, which is fitted with a different washer for different sized roofs. There are also other minor details which I have omitted, as they do not affect the principle of the apparatus. After the rain has ceased, the receptacle tips back again into Position 1.



Position.1. Position.2

FIG. 49.

The separator has a marked effect in cleansing the water sent to storage, but the objection to it is, that a more or less considerable portion of the rain must be wasted. The inventor suggests that a separate tank should be constructed to receive the first washings from the roof, which are sent through the pipe, W, but this water would, of course, be rather dirty, and only available for rough purposes. When circumstances are favourable, and it is not essential to collect the whole of the rain-water, the separator may be usefully employed, but in many cases a simple filter, such as that previously described, is to be preferred.

Before leaving the question of rain-water, it should be mentioned that this water, on account of its softness, frequently has a strong action on lead, and that leaden pipes and cisterns should therefore never be used in connection with it. The best material to use for the pipes is iron, or, in some instances, "lead encased block tin pipe," in which the tin is not a mere coating, but of a sufficient thickness to protect the lead satisfactorily (see Fig. 43). This latter point is of the utmost importance, as, if the tin were perforated or broken through, the danger of the lead being acted on would be increased in consequence of galvanic action being set up. The cisterns should be of slate or of galvanised iron.

Water Supply Arrangements Generally.

It would be out of place in this Appendix to go into particulars as to the design of works for the supply of water to country houses, or as to the mechanical details involved, but a few general observations may be of use. No house can be considered to have a perfect water supply in which the water is not delivered to the highest part of the building, and the first object in planning waterworks should therefore be to obtain if possible a supply from a spring at a sufficient height to deliver the water to the top of the house by gravitation. There should always, if possible, be a reservoir or tank at a sufficient elevation to command the house, and this should be as near the house as can conveniently be arranged. The main from the reservoir to the house should be of large size, so as to be available for fire service, and the water should, as far as possible, be drawn directly from the main, not from subsidiary cisterns. In certain instances a gravitation supply might be obtained by constructing on elevated grounds an artificial gathering surface, formed of concrete or other impervious material, and collecting the rain-water flowing off it into a covered tank.

When a gravitation supply cannot be obtained, pumping must be resorted to in some form or other, but even then an elevated reservoir should, if possible, be constructed, or failing it, a tower with an elevated tank above the highest part of the roof. In small houses one must often be contented with a tank in the roof of the house itself, but this obviously affords less protection in case of fire.

One of the simplest and most economical arrangements for raising water when there is a sufficiently copious spring is an hydraulic ram. A good deal of misconception exists in the public mind as to the working of the machine. It is often stated the ram will raise one-tenth of the water which works it, and advertisements may be met with in which it is stated that special rams will raise one-third of the water passing through them. Now all this is misleading. The proportional amount of water the ram raises cannot be a fixed quantity, but must vary in different cases inversely as the height to which the water is lifted; that is to say, the greater the lift the less the quantity raised. Thus, if a ram raises one-third of the water which works it to a height of 20 feet, it will only raise one-sixth, or less, of that water to a height of 40 feet, the quantity raised in fact varies in the relation of the fall to the lift. If the fall working the ram is one-third of the lift, the ram cannot, by any possibility, raise more than one-third of the water which works it, and in practice will not raise much more than one-sixth. If the fall is one-tenth of the lift, the ram cannot possibly raise more than one-tenth of the water working it, and in practice will only raise about one-twentieth.

If the spring is not of sufficient volume to work an hydraulic ram, but power can be obtained from a stream, the best way is generally to employ pumps driven by a water-wheel, and conduct the spring water to them. There are special forms of hydraulic ram which will work with dirty water and raise clean water, but these are rather complicated, and not generally to be recommended.

When water power cannot be obtained, wind engines may sometimes be resorted to. The objection to wind power is that the wind is very uncertain, and that frequently when most water is wanted there will be least wind to raise it. This objection, however, can be overcome in cases where there is high ground near the house on which a reservoir or tank can be constructed of sufficient size to store an ample supply of water for the longest period, during which the wind engine will either not work at all or only work fitfully at intervals. No precise rule can be given as to the number of days' supply which such a reservoir ought to be capable of storing, as this will vary greatly in different cases. The question will be affected by a number of circumstances, such as the locality, the position of the wind engine as regards exposure to the wind, the height of the wind engine above the ground, and the margin which is allowed between the power of the wind engine and the work it has to do. In a case where all the circumstances are favourable, a reservoir which is capable of storing ten days' supply may be an ample provision, whereas, in a case where the circumstances are unfavourable, it may be necessary to provide a reservoir which will hold twenty days' supply, or even more. It is an excellent plan to supplement the wind engine by horse power, to be used if occasion require, and where this is done the capacity of the reservoir may be reduced.

In many cases steam engines, gas engines, or hot air engines must be resorted to. Which of these should be preferred will depend on a number of circumstances, which it would take too long to discuss here.

Lastly, there is horse power and manual labour. When the quantity of water to be raised is not large, horse power may sometimes be advantageously adopted, especially if there is a reservoir or tank which holds two or three days' supply, so that the horse need not work every day. It is also useful as a supplementary power in case of break down of other machinery. Pumping by hand cannot be recommended, except for small houses and low lifts.

DISPOSAL OF SEWAGE.—CESSPOOLS.

The question of the ultimate disposal of the sewage has hitherto been too often neglected by the owners of country houses. It has generally been considered that if a system of drains be constructed to carry the sewage away from the house, all that is really requisite for health has been done, and that it is comparatively unimportant what becomes of the sewage ultimately. This is a very short-sighted view of the question, as a slight consideration of the matter will show.

By far the most usual method of disposing of the sewage of country houses is to convey it into cesspools and either to let the liquid contents of the cesspools soak into the ground or overflow by means of a drain into some ditch or watercourse. It has already been shown, when speaking of the water supply, what very grave dangers to health arise from leaky cesspools, and it would almost seem unnecessary to say anything more in condemnation of this practice. It is one, however, which is so universally adopted, even up to the present day, and by the most eminent architects, that a little more explanation is perhaps required. I have frequently heard it stated, as a great point in favour of porous cesspools, especially in the chalk, that the filth disappears so rapidly that they never require to be cleaned out. One would have thought that this would tell its own tale, but it is not so. The prevalent idea seems to be that as long as the sewage disappears everything must be right, and no further thought need be taken about the matter. If, in exceptional cases, any question is raised as to what becomes of the sewage after it has disappeared, the usual answer is that it really does not much matter, as the sewage will be thoroughly filtered in its course through the ground before it reaches any wells. Now, apart from the consideration that wells are not intended to supply filtered sewage, there is really no security that the sewage will be thoroughly filtered. The liquid frequently escapes from the cesspools through fissures and veins which become so filled with filth that they would poison even pure water passing through them. There is also an absence of that free oxidation which is so powerful an agent in the purification that takes place in the sewage when it is applied to the surface of land in the open air.

The construction of a watertight cesspool, and the provision of an overflow drain, although it may prevent the contamination of wells, introduces a new series of troubles. If the house is very small, and with an inefficient water supply, the overflow from the cesspool may be so inconsiderable that it may pass unnoticed for a long time; but even in such cases, sooner or later, a nuisance will be created. In the case of a house of considerable size, on the other hand, with an ample water supply, the nuisance arising from the overflow drain will be unmistakeable. Moreover, most frequently the nuisance will extend far beyond the neighbourhood of the house which causes it, and will pollute streams and watercourses which are used for drinking purposes.

This, it must not be forgotten, is expressly forbidden by the law of the land. According to the Rivers Pollution Prevention Act, passed eight years ago, every person who causes or permits sewage to flow into any stream or watercourse shall be deemed to have committed an offence against the Act. Exception is made in favour of a person discharging sewage into channels which had been used for carrying sewage into streams before the passing of the Act, but only if he can show "that he is using the best practicable and available means to render harmless the sewage matter so falling or flowing or carried into the stream."

Without entering into the question why this Act has hitherto remained comparatively a dead letter, it may certainly be stated that no sound reason can be shown why the Act should be systematically evaded, and I think it only requires the question to be properly understood by owners of country houses for a great improvement to be effected. Perhaps I may be excused for adding that it is specially incumbent on country gentlemen who as legislators have assisted in passing the Rivers Pollution Prevention Act to see that they do not knowingly contravene it in the case of their own country houses.

The pollution of watercourses and streams by the overflow from cesspools can, it is true, be obviated by abolishing the overflow drain and pumping out the contents of the cesspool, when full, for use as manure on land. But independently of the trouble and nuisance involved in such an operation, it will not get over other serious evils which are inseparable from cesspools. The primary object of all good drainage is the complete removal and destruction of refuse matter before it has time to putrefy. The object, on the other hand, for which cesspools are made, is precisely the reverse, viz., the retention of foul matter, hence putrefaction must inevitably take place in them. The cesspool, in fact, constitutes a huge manufactory for the production of foul gases, which must of necessity escape somewhere. If special precautions are not taken they will escape into the house drains in connection with the cesspool, and thus cause the most serious danger to health. If, on the other hand, the foul gas from the cesspool is effectually cut off from the house drains, and allowed to escape by outlets provided for the purpose, these will in themselves very probably create a nuisance. In fact, to ventilate a cesspool efficiently and inoffensively is almost always a difficult problem.

There is also an evil of another kind inseparable from cesspools, and one that has a special bearing upon our present subject, viz., that they cause the sewage to become much fouler than it otherwise would be, and thus greatly increase the difficulty of its disposal. It is well known by those who have studied the subject that fresh sewage has comparatively little smell, and may be applied to land without giving the slightest offence. Putrid sewage, on the other hand, has an extremely offensive smell, and if distributed over land is certain to cause more or less nuisance.

The contents of a cesspool, as previously explained, cannot be anything else but putrid sewage, in the worst possible condition for being dealt with. In fact, it is hardly going too far to say that in most cases, as long as cesspools are retained, it is practically impossible to dispose of the sewage inoffensively.

Before proceeding to consider what is the proper substitute for cesspools, it will be well to say a few words about a misconception which often exists as regards the effect of the use of earth-closets instead of water-closets in getting over difficulties about sewage. It is frequently assumed that if there are no water-closets there will be practically no sewage, as the liquid refuse from the house will only be dirty water, which can do no harm, and about which no thought need be taken. This is altogether a mistake. The introduction of earth-closets in some cases may, no doubt, simplify the question to a certain extent, but the liquid refuse, or "slop-water" will still be sewage, and will not be very much less in quantity than if there were water-closets.

If we only look at the question from the strictest scientific point of view as to the causation of typhoid fever and disease of that kind, we may say that sewage is less dangerous to health when the human discharges are kept out of it. Even from this point of view, however, we cannot say that it is harmless, as there is at least one striking case on record of typhoid fever having been spread by dirty water from a wash-house, in which the linen of a man suffering from this disease had been washed. If, on the other hand, we consider the question from the point of view of offensive smell, we shall find that there is practically no difference between the sewage from houses with earth-closets and that from houses with water-closets, or if there be any difference, it is in favour of the water-closet sewage.

The Commissioners appointed to inquire into the best means of preventing the pollution of rivers examined the sewage of a large number of "middenstead"* and water-closeted towns, and found that the sewage from the middenstead towns was practically as impure as that from water-closeted towns. They also found that the case was not substantially altered when earth-closets were used, and they conclude their remarks on this point by saying, "It seems hopeless, therefore, to anticipate any substantial reduction of sewage pollution by dealing with solid excrementitious matters only." As regards offensive smell, I may refer to some experience I have had myself. It used to be a common practice with architects, when laying out the drainage of a country house, to separate the slop-water from the water-closet sewage, and to construct two entirely separate systems of drains and cesspools for these two kinds of sewage. I have had to superintend the reconstruction of the drainage of large buildings where this separation was made, and I have always found, when removing the cesspools, that those which contained slop water only were decidedly more offensive than those which contained water-closet sewage.

---

* Having privies.

From the facts above stated it is clear that, whether there are water-closets or not in a country house, there will always be a considerable amount of liquid sewage, for the disposal of which special means must be provided.

The question of the best method for the disposal of sewage has had a great deal of light thrown on it by the experience which has been obtained in the sewerage of towns. When systematic sewerage was first introduced, the ruling idea was to remove the sewage from the town as quickly and easily as possible, and it was therefore very generally discharged into rivers and water-courses. In many cases this soon created an intolerable nuisance, and then various means were taken to purify the sewage before its discharge into the stream. One of these methods, greatly in favour with small towns (and still occasionally used for villages and country houses), is the passage of the sewage through filtering tanks. Experience, however, showed that these tanks would not answer. It was found, on the one hand, that if the filtering material were not fine enough to produce any real classification of the sewage, the filter almost immediately choked and became impervious to the passage of the liquid; and, on the other hand, that if this difficulty were avoided by merely aiming at rough straining and subsidence, the classification which was effected was so slight as practically to be of no value. For these reasons the simple filtering tanks have been gradually given up. Some towns have adopted various chemical processes for the treatment of the sewage, but the great majority of the towns have eventually resorted to the application of the sewage to the land in some form or other.

APPLICATION TO LAND.

The various chemical processes for the purification of sewage are not suitable for isolated country houses, but in this case the natural as well as the best practical means of purification is application to cultivated land. Suitable soil, properly prepared and judiciously used, affords all the conditions required for the chemical changes which are necessary for the purification of sewage. As has been pointed out by the Rivers Pollution Commission, "sewage traversing the soil undergoes a process to some extent analogous to that experienced by the blood passing through the lungs in the act of breathing. A field of porous soil irrigated intermittently, virtually performs an act of respiration, copying, on an enormous scale, the lung action of a breathing animal; for it is alternately receiving and expiring air, and thus dealing as an oxidising agent with the filthy fluid that is trickling through it."

Hence it will be seen that the conditions essential to the successful purification of sewage by land, are an absorbent and well-aërated soil and intermittent application of the sewage. If the land is not naturally dry, artificial under-drainage must be adopted. Porous soils are the most suitable. Clay soils are very undesirable, though with great care they can be made available.

When the above conditions are complied with, fresh sewage can be applied to land without any nuisance, if only a reasonable amount of care be taken in the distribution. With putrid sewage the case is altogether different, so much so, that where nuisance arises from irrigation, it will generally be found to be due either to putrefaction having commenced before the sewage is applied to the land, or from the sewage being improperly distributed, so that it stagnates in pools on the land and thus putrefies.

As the absence of any offensive smell is a most important point in the disposal of the sewage of country houses, it is clear, from what has been stated, that the greatest care must be taken to avoid any arrangement which facilitates putrefaction. Of course, therefore, all cesspools and drains of the deposit should be done away with, and the sewage conveyed to the land as rapidly as possible by a self-cleansing system of drains, constructed on the principle explained in the first part of this Handbook. There is, however, another source of putrefaction which is frequently overlooked. It is usual before discharging the sewage on to land to pass it through one or more tanks, in order that the solids may be deposited, and the liquid only flow on to the land. The sludge which collects in the tanks is removed at intervals, generally of considerable length. Now this arrangement of necessity gives rise to putrefaction, and when once putrefaction has commenced, the whole of the sewage which passes through the tank becomes tainted. It is therefore essential to avoid settling tanks of this kind, or any arrangement for the interception of the solids which retain the sewage for a sufficient length of time for putrefaction to commence.

In some cases the sewage may be delivered on to the irrigation ground just as it comes from the house, without any interception of solids at all, but these cases form the exception, and, under ordinary circumstances, the solids must be intercepted. One of the simplest ways of doing this, without causing putrefaction, is by means of a small straining chamber such as that shown on Fig. 50.

The distinguishing feature of this arrangement is, that there is no tank or depression for the sewage to collect in, but that the bottom of the chamber is on the same level as the bottom of the drain, so that the liquid sewage passes through the chamber without any obstruction. The interception of the solids is effected by two strainers, A A, which consist of small iron rods fixed in an iron frame, and so arranged as to be movable. The bottom of the chamber is constructed of concrete, smoothly cemented and rounded, as shown in the cross section, so as to form a sort of channel for the passage of the liquid and enable the solids to be more readily cleaned out. This bottom also has a rapid fall from the inlet to the outlet, which still further facilitates the rapid passage of the liquid. The sides are usually formed of brickwork, and the whole is covered by a light wooden lid, B, which

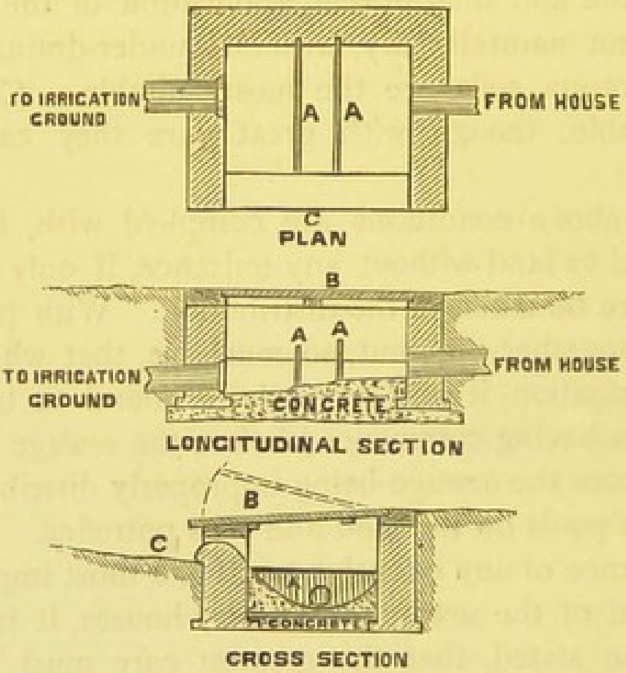


FIG. 50.

opens on a hinge, as shown by the dotted line. Ventilation is provided underneath the lid at C. In order to remove the solids, a man stands at C, when, after opening the lid, he can scrape the solid matter with a hoe over the rounded edge of the side, as shown at C, on the cross section. In some cases a perforated bucket or movable iron basket may be used instead of the strainer. The solids should be mixed with a little dry earth, and they will then be quite inoffensive.

In order that the straining chamber may effect its object, it is essential that the solids should be regularly removed every day or two, otherwise decomposition will take place and cause more or less smell. At first sight this may appear a serious objection to the arrangement, but experience shows that the trouble involved is so very slight as not to be worth consideration. Much the best plan, and the one which gives the least trouble in the end, is to let the removal take place every day. If this is properly done, it is perfectly astonishing what a small amount of solid matter is intercepted even from a large country house, and how easily and quickly it is dealt with. If the solids be mixed with a little dry earth, the resulting compost will be similar to that which is obtained from earth-closets, only much less in amount. In fact, a few spadesful of earth are more than sufficient to deal with all the solids from a large house.

The difference between the small amount of inoffensive solid matter obtained from such a straining chamber as that described, and the large amount of extremely foul deposit collected by one of the ordinary settling tanks, is so striking and so important from a sanitary point of view, that it is worth considering what is the reason of the difference. The explanation is simple. In the ordinary settling tanks liquid sewage is retained as well as solid matter, and when the solids decompose they mix with the liquid, and form a semi-fluid mass much greater in amount than the actual solids. Paper and other fibrous materials, such as rags and portions of cloths, play a very important part in the matter, as has been well pointed out by Professor Virchow of Berlin. These, when rotten and mixed with the semi-fluid organic matter, form a glutinous mass of the foulest and most impracticable kind, technically known as "sewage sludge." In the case of the straining chamber, on the other hand, the liquid sewage all runs away, carrying with it some of the finer solid particles, and only the larger solid particles with the paper and rag are retained. As this is removed daily, no decomposition or rotting of the paper takes place, so that there is really no formation at all of sewage sludge in the ordinary acceptation of the word.

The next point to be considered is the land over which the sewage is to be distributed. The selection of this land must depend to a very large extent on the local conditions. If it can possibly be arranged, the sewage should be conveyed to the land by gravitation, and this, together with considerations of amenity, will in most cases considerably limit the selection. It is also essential, as previously mentioned, that the land should either be naturally dry or artificially under-drained, so that if the latter is necessary, an outfall for the under-drainage will be required. Osier beds, which in some cases may be advantageously used for the disposal of sewage, are apparently an exception to this, but not really so. In their case it is not generally admissible to lay pipe drains, but there should always be deep ditches, and these of course require an outfall.

As regards the quantity of land required, an acre will be sufficient for a large mansion, and a quarter of an acre for a good-sized country house, and an eighth of an acre for a moderate-sized house with, say, ten or twelve occupants. If the land is of a very porous description, considerably less than the above quantities will do. Clay land should be avoided wherever possible. In cases where it is the only land available it may be used, if special precautions are taken in the under-drainage and preparation of the land. Or a natural filter bed may be formed on the principle of "intermittent downward filtration," by excavating a small portion of the land 6 feet deep, laying in drains at the bottom, burning the clay into ballast, and replacing it in alternate layers with natural soil. If treated in this way, an exceedingly small plot of land will suffice, for instance, a sixteenth of an acre would do for a large country house with forty or fifty occupants. Where so small an area of ground is employed, however, very special care must be taken in the distribution of the sewage. The application must be rigidly intermittent; that is to say, the sewage must never be turned on to the same portion of the plot for more than a day, and after a portion has received the sewage, it must be allowed to rest for a couple of days before receiving any more.

In case of sewage farms for towns, a considerable outlay is frequently incurred in the construction of carriers and sluices, and the formation of the land into beds with regular slopes, but this is generally not necessary in the case of country houses where the quantity of sewage to be dealt with is comparatively so small. The aim should be to arrange everything in the simplest possible manner: and with the exception of the main carriers which bring the sewage on to the land, the carriers can generally be formed by small channels or "grips," cut in the ground, and the sewage can be diverted from one corner to another simply by putting a turf across the channel. The essential point is that the sewage should be distributed evenly on the land, and not be allowed to lie in pools. It is also important that the sewage should be turned every day or two on to different portions of the land.

Paradoxical as it may seem, the difficulty of the disposal of the sewage of country houses on land arises rather from the smallness of the quantity to be dealt with than from its magnitude. The smallness and irregularity of the flow frequently causes considerable trouble in distributing it evenly over the land. This difficulty may be overcome by means of the self-acting flush tank described on p. 203. The method of using the flush tank will vary in different cases. In some cases the whole of the sewage may be collected in the tank, and the discharge from the tank conducted on to the land. When this is done, the flow on to the land will be intermittent; for a considerable time there will be nothing flowing, and then when the flush tank discharges there will be a copious flow. In other cases a portion of the sewage only may be collected in the flush tank, and in other cases, again, it may be advisable simply to depend on a flush tank fed by clean water, and used primarily for flushing the drains.

SUB-IRRIGATION.

Hitherto we have only considered the application of the sewage to the surface of the land, but cases occur, especially with reference to cottages, where this is impracticable, and what is called "sub-irrigation" may then be employed. This consists in discharging the liquid sewage from a flush tank into open jointed pipes, laid about 9 inches below the surface, when the sewage will force itself out of the joints into the surrounding soil, and feed the vegetation.

Fig. 51 shows an example of the application of sub-irrigation for disposing of the slop-water from a gardener's cottage, where an earth-closet is used. A is the flush-tank receiving the waste water from the sink in the cottage, A B is a watertight drain, B C is an open jointed main drain, and D D D D are open jointed branch drains laid underneath the garden. The black dots, where the branch drains join the main drain, represent small brick chambers, so arranged that the slop-water can be diverted at pleasure into any branch drain. The garden in this case consisted of porous land, and did not require under-drainage, but often this is necessary. Fig. 52 shows the method of laying the sub-irrigation drains on a continuous bed formed by dividing a large pipe longitudinally into two equal parts. This bed is not disturbed when the pipes are taken up to be cleaned (as is necessary occasionally), and this ensures their always being relaid in true position. The small pieces laid on the top of the pipes are for keeping out any sand or mould which might otherwise find its way through the open joints. As the pipes are so close to the surface they can easily be taken up to be cleaned, but frequently all that is necessary is to remove two or three pipes here and there and pass a cane or rod throughout the intervening lengths.

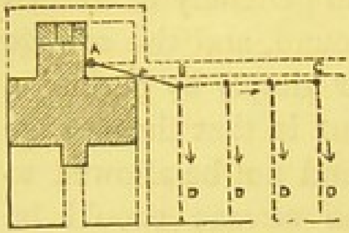


FIG. 51.

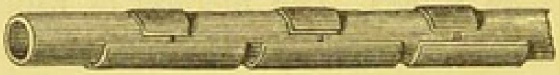


FIG. 52.

Sub-irrigation is chiefly useful in taking slop-water from cottages, as in the case just described, but by means of special arrangements it can also be employed for disposing of the whole of the sewage from houses where water-closets are used. Where surface irrigation can be adopted it is always to be preferred, but cases arise where the choice lies between sub-irrigation or porous cesspools, and thus there can be no hesitation as to which to adopt. The difficulty in applying sub-irrigation to houses of any size consists chiefly in the grease and fat, which in some cases rapidly choke the sub-irrigation pipes. Fat traps to a certain extent overcome the difficulty, but not altogether, unless they are made so large as to constitute cesspools, wherein the grease will putrefy before it is discharged into the sub-irrigation drain. This is the arrangement adopted in the United States, where sub-irrigation has been largely and successfully used for country houses. I confess, however, that I can hardly bring myself to recommend a remedy so contrary to sound sanitary principles, and I would rather trust to the frequent cleaning of the sub-irrigation pipes. It is hardly necessary to add that of course great care must be taken not to adopt sub-irrigation near any well.

The question of the disposal of the sewage should always be considered before laying out the system of drainage of a country house. Wherever possible, the sewage should be conveyed to its point of ultimate disposal by gravitation, and in cases where, owing to the contour of the ground, the fall is slight, the precise design of the branch drains round the house frequently makes all the difference between success or failure in obtaining an outfall on to the land by gravitation. As an instance of what can be done in difficult cases by making all the details subservient to the scheme of disposal, the following case, taken from actual practice, may be of interest.

Fig. 53 represents the system of drainage carried out at a large country mansion, near Nuneaton. The mansion F was situated on low ground near the river, and the former system of drainage discharged into the river. The question was further complicated by the land near the river being liable to floods. My first idea when I examined the locality, was, that it would be absolutely necessary to pump the sewage on to higher land, but on having accurate levels taken it was found that on the other side of the river, at B on the plan, there was a small piece of land, which, if enlarged by excavation, would be sufficient and low enough to receive the sewage by gravitation. Floods from the river could be excluded by banking the land, and efficient under-drainage could be provided by making use of a deep land drain, A, which crossed under the river, and had its outfall at a mill tail some distance lower down. The great difficulty was to convey the sewage across the river, as any pipe bridging the river or any embankment between D and C on the low ground opposite the mansion would have been an eye-sore, and was out of the question. The only possible plan, was, therefore, to cross under the river by means of an iron pipe, or so-called inverted siphon dipping under the river at E, and then gradually rising again from D to C. This introduced a new difficulty, viz., that in

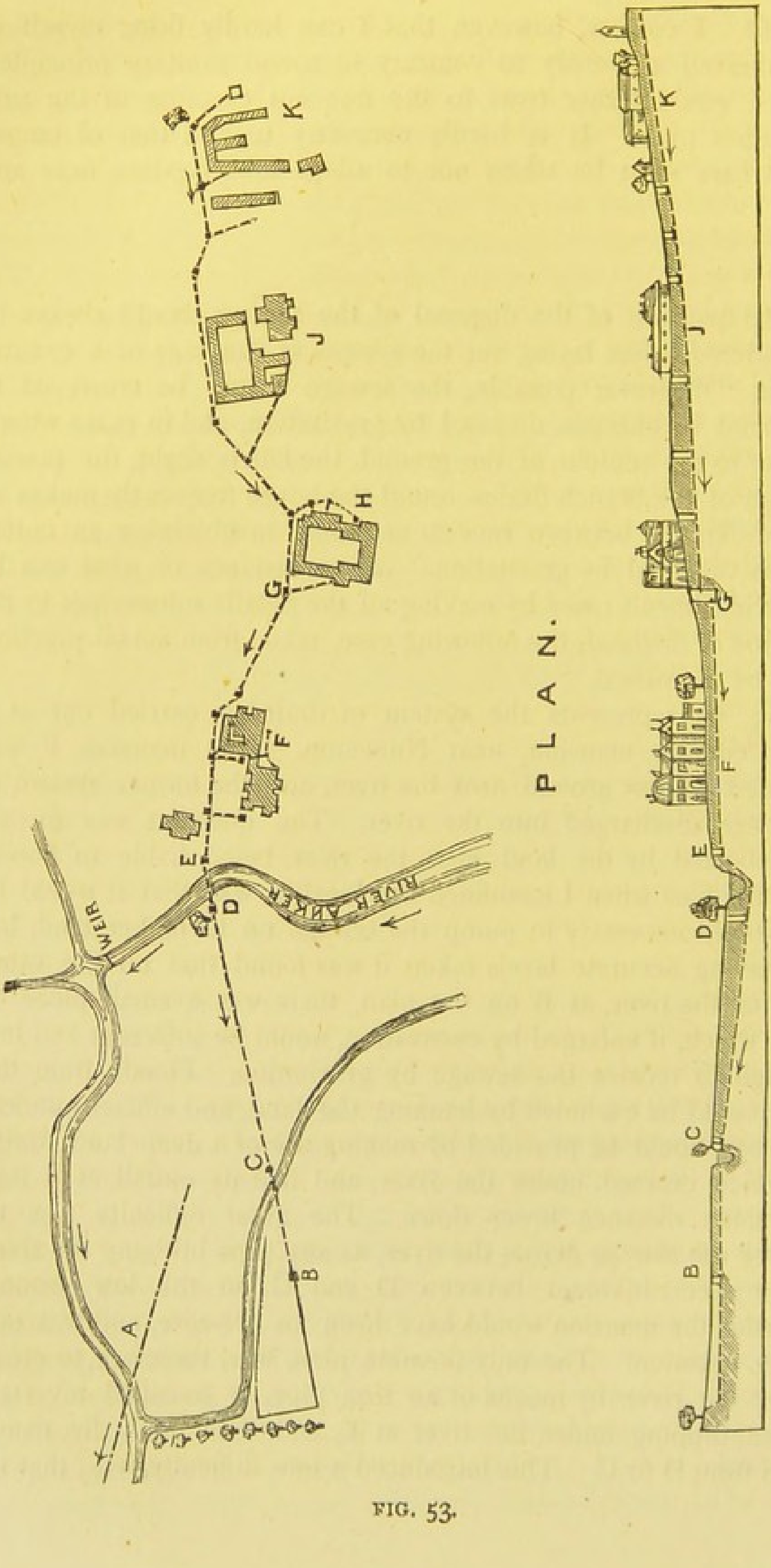

PLAN.
SECTION
RIVER ANKER
WEIR
A
B
C
D
E
F
G
H
J
K

FIG. 53.

order to make an inverted siphon of such length work properly, it was absolutely essential to give it considerable fall, which would of necessity reduce the fall (already very slight) available for the rest of the drainage. This difficulty was finally overcome in the following way. The drainage from the labourers' cottages, K, farm-yard, laundry and rectory, J, and the stables, H, was collected in a large automatic flushing tank at G. From G to E the main drain was laid at a very slight fall (1 in 330) which enabled the upper end of the inverted siphon at E to be kept at a sufficiently high level to give the requisite fall from E to C. The flush tank served not only to keep the flat drain between G and E clean, but also to force the sewage with considerable velocity through the inverted siphon. The effect of the rush of water from the flush tank was well shown by putting an india-rubber ball into the mouth of the inverted siphon at E, when the ball was carried through the iron pipe under the river and up the long rising incline from D to C, finally emerging into the man-hole at C. In consequence of keeping the main drain so high at E, it was very near the surface of the ground at the mansion, F, but by specially designing all the house connections to meet this, a sufficient fall was obtained for the branch drains round the mansion. The whole of the drainage arrangements described have been working satisfactorily for some years.

Of course cases arise occasionally where it is absolutely impossible to dispose of the sewage by gravitation, and then pumping must be resorted to. The nature of the power which should be employed will vary according to circumstances. Sometimes water power can be obtained. For instance at the mansion, near Nuneaton, if it had been found necessary to pump the sewage, I should have endeavoured to utilise the small fall there was on the river at the weir below E to work a turbine for pumping the sewage. In other cases a gas-engine, or a hot-air engine, or a steam-engine, or occasionally horse-power must be employed.

When pumping has to be resorted to it will be necessary to have a tank at the end of the main drain to receive the sewage, and for the pump to draw from. Special attention must be paid to the design of this, so as to prevent it being in every sense a cesspool. The solids should be intercepted before the sewage is discharged into the tank, so as to prevent the formation of sludge. The tank should be amply ventilated, and so arranged that the whole of its contents can be pumped out daily, and thus putrefaction be avoided. The system of house drains should of course be cut off from the tank by a disconnecting manhole.

In conclusion, I would say to any one who still feels doubtful whether sewage can be easily and inoffensively disposed of as has been stated, go and see for yourself. There are now many country houses where irrigation with fresh sewage is successfully adopted, and a visit to one of these cannot fail to instruct and enlighten.

HEALTHY

FURNITURE AND DECORATION.

BY

ROBERT W. EDIS, F.S.A., ARCHITECT.
AUTHOR OF 'THE DECORATION AND FURNITURE OF TOWN HOUSES,' ETC , ETC.

CONTENTS.

CHAPTER I.

PAGE
Preliminary remarks—Unhealthiness of modern houses—Ventilation and constructive decoration—Healthiness of electric lighting, in comparison with gas, oil-lamps, and candles . 291

CHAPTER II.

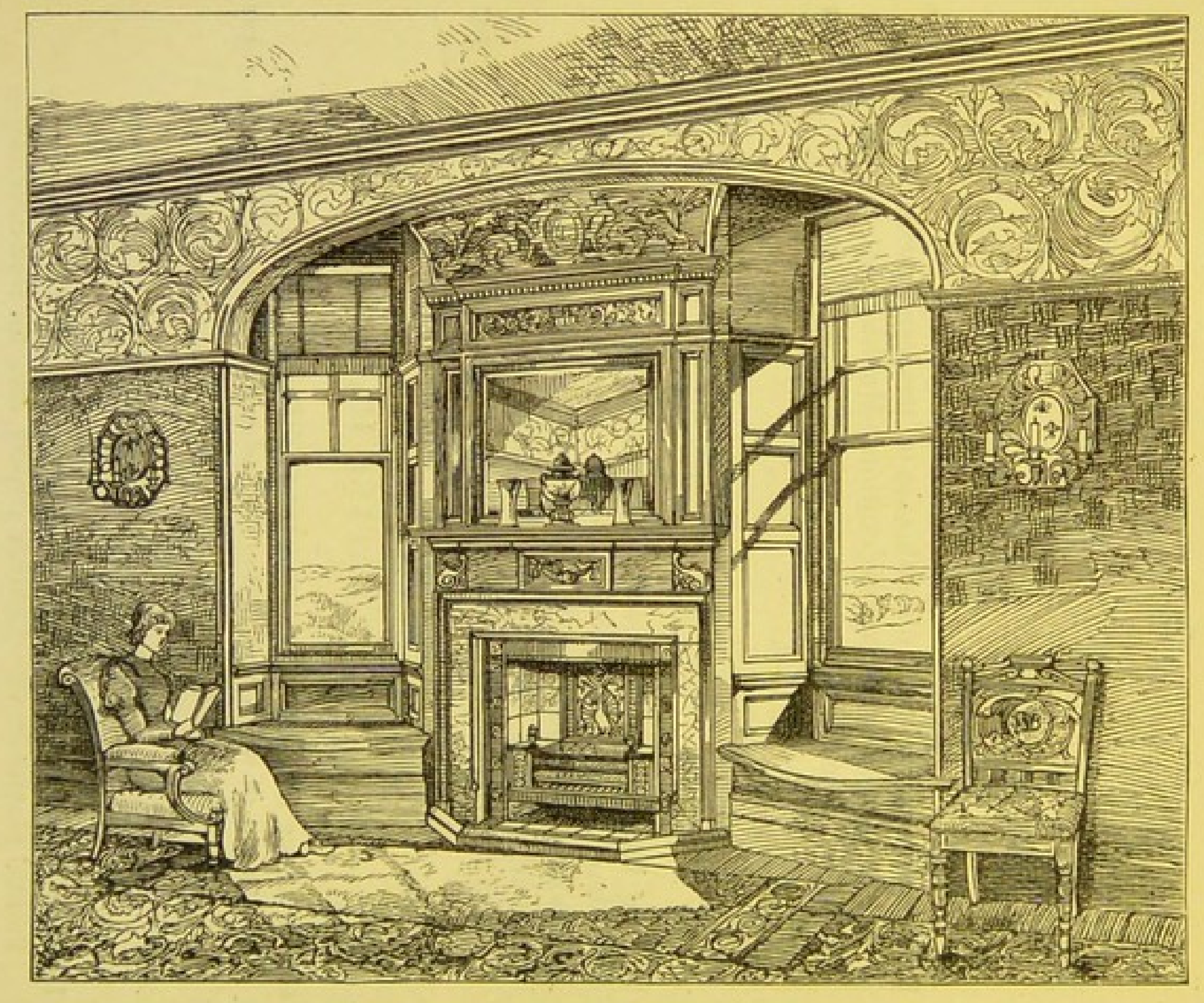
Present bad system of leasehold tenure—Diseases attributable to badly built and fitted houses—Sanitary decoration—Healthy treatment of floor and wall surfaces—Influence of colour on the optic nerves—Paperhangings—Washable papers—Unhealthiness of stuff hangings 307

CHAPTER III.

Constructive fittings—Arrangement of different rooms—Healthy treatment of walls and fittings—Bedrooms and nurseries . 327

CHAPTER IV.

Lavatories—Mantel-pieces—Smaller fittings of the house—Ornamental plaster-work—Leather papers, &c., for wall covering—Conclusion 353



SKETCH SHOWING RECESSED FIREPLACE WITH WINDOW SEATS.

HEALTHY FURNITURE

AND

DECORATION.

CHAPTER I.

Preliminary remarks—Unhealthiness of modern houses—Ventilation and constructive decoration—Healthiness of electric lighting, in comparison with gas, oil lamps, and candles.

In accepting the invitation of the Executive Council of the International Health Exhibition to write a short Handbook on 'Healthy Furniture and Decoration;' I am anxious to set forth in as simple and common-sense a manner as possible, and to the best of my ability, various practical suggestions, which I trust may be found of service to those who wish to make their houses not only artistic and comfortable, but sanitary, in the general acceptation of the term; and to point out various evils in the ordinary manner of decoration and furnishing, which seem to me fraught with danger to the healthy enjoyment of the dwelling, and, which, with a little thought and care, may be to a large extent got rid of.

I have nothing in common with the "clap-trap" conventionalities and eccentricities of those so-called æsthetic schools which insist on certain styles of decoration and would-be quaint designs in furniture, which, to my mind, are in no way really artistic; nor shall I pretend to lay down any special laws from which there shall be no departure, but I shall endeavour, in as practical a manner as I can, to point out the means by which the more healthy treatment of the houses we live in may be carried out, consistent with general good artistic effect, truth of construction, comfort, utility, and general convenience.

In condensing into short handbook form the various suggestions which I shall make for the more healthy treatment of the houses we live in, I must necessarily quote to a certain extent from various books and articles which I have before written on similar subjects ; but I hope these quotations, abbreviated as they must necessarily be, may be permitted, as it would be impossible, in the writing of a short popular treatise on sanitary decoration and furniture, to avoid trenching to some slight extent on what I have previously written in my book on the 'Decoration and Furniture of Town Houses,'* and in my article on "Internal Decoration" in 'Our Homes.'†

In the early portion of this year I was invited by the Council of the Society of Arts to give a course of Cantor Lectures, and chose for my subject, "the Building of Town Houses," with special regard to their arrangements, sanitary construction and decoration, and general fitting up from a health point of view, and I propose, with their consent, to embody in this handbook many of the suggestions made in the three lectures on these special subjects, which I originally intended to enlarge into book form. In the designs which illustrate my remarks, I have endeavoured to set forth such simple arrangements of the decoration and fitting up of wall and floor surfaces, which seemed to me might best exemplify the various views set forth in the following pages : and which, in some form or other, might illustrate the principles which I have so long advocated as to the healthy fitting up of the homes we live in.

For many years I have made the subject of decoration and furniture my especial study, and I hope that I may be able to give some information and suggestions on the various points which should be specially observed and insisted upon, in any building, wherein sound construction, healthy arrangement, common-sense treatment of the rooms, and practical knowledge in their general fitting up, are all important; where health, cleanliness, and comfort, and economy of service and labour are considered necessary.

---

* London : Kegan Paul & Co., 1881.

† 'Our Homes, and how to make them healthy,' Cassell & Company, Limited, London, Paris, and New York, 1883.

I use this phrase advisedly, for day by day and year by year, I see in London and other large towns, hosts of houses erected of the flimsiest construction, built with the most trashy materials, and finished without the slightest regard to the laws of health, comfort, or ordinary artistic character, externally or internally.

The speculative builders—and, under this term, I mean not only the host of small men, who help to raise, fungus-like, the streets of flimsily built cottages, and fourth and fifth rate houses, which disgrace our suburbs, and form the houses of the bulk of our working classes; but also those larger capitalists, who have carried out, in the last twenty years, the innumerable streets, squares, and terraces, in our more fashionable quarters, and whose erections certainly, from an art point of view, are, to a large extent, equally to be condemned—have too long had their way, without control of any kind, save that which is provided for under the Metropolitan Building, and other local Acts, and which simply permit of the District Surveyors insisting upon certain thicknesses of walls, but gives them no power to reject inferior materials, or to prevent the too often scamping and utterly unsound work, the utter disregard of all known sanitary laws, or the commonest precautions to insure health and comfort.

It is surely time that every house, erected in the great centres of habitation, should have some systematic supervision, so that ordinary precautions shall be insisted upon, to secure proper sanitation, to prevent the use of grossly inferior materials, and to prevent these plague-spots being formed in our midst; for it must be borne in mind that every house built under the system I have condemned, not only tends to the individual discomfort of the special occupier, but adds materially to the unhealthiness of a neighbourhood.

The wretched system of building which obtains in so much of, what is called, the 'speculative' class of houses of the middle and lower classes, seriously interferes with any real improvement in general decoration and furniture. "In the homes of the poorer classes the character of the work and workmanship is often of the most inferior kind; cheap, nasty, and absolutely unhealthy. All this wretched system of building, for which we architects are in no way responsible, exercises an important influence for evil on those who are condemned to live in such houses, and, to my mind, fosters a feeling of carelessness and untidiness which affects materially the mental, if not the bodily, health of the occupiers. How is it possible to be cleanly or tidy in a house, in which the walls are breaking out into patches of damp, the woodwork of the floors, or doors, opening out into yawning cracks, resting-places for dirt and dust, which no amount of cleaning can get rid of? How can floors be kept clean wherein the joints and crevices are filled with decomposing filth? Or how can walls be cleansed or dusted which are covered in places with mould, or blisters, from faulty and bad materials? The most tidy housewife might well soon tire of attempting to put her house in order, when all these evils, of bad workmanship and bad materials, are meeting her at every turn, and thus she is often disheartened, and the moral tone of healthiness, engendered by the desire to set things right in her house, and to make all things about her clean and tidy, is lost, by the feeling that no amount of care, on her part, can make clean or tidy the miserable materials on which she has to work; and the spirit of tidiness in the house, once done away with, leads to untidiness in other things; makes a house dreary, wretched, and unclean, no longer the pleasant cheerful home, but a miserable and dirty abode, in which the want of cleanliness leads, in a short space of time, to want of health. I have written thus strongly upon the moral effect of bad building in the homes of the poorer classes of the community, because I feel that it is absurd and inconsistent to urge any better system of design and decoration, which shall not be useful to them, as well as to ourselves, and that it is hopeless to suppose that we can surround ourselves with beautiful art work, if we leave the workers out in the cold, and think not as much for the improvement of their dwellings as our own. If everything about our cottage dwellings is miserable and squalid, hideous and unartistic, how can we expect that those who must find the hearts and the hands to carry on our own work well and properly, can be attuned to truth and beauty in form or decoration, when their own surroundings are hideous and unartistic? If we are to expect any real art knowledge in our workmen, we must surround them with things of beauty; all the teaching in the world in schools of art will not produce a race of art workmen, if the lessons are not exemplified, in however humble a degree, in their own home life, and if the work and design which they have about them are tasteless and ugly."

It has been my lot to inspect from time to time many of the so-called better class of speculative builders' houses. I have in many cases found the walls very badly built with inferior materials, porous bricks and wretched mortar, externally covered over with Portland cement to hide their deficiencies, with masses of cement mouldings overlaying their general faces, stuck on to flimsy brick or stone cores, cast cement balustrading, party-walls honeycombed with flues roughly pargetted (as the internal lining of plaster is called), and in many cases the plugging for joiners' works of all kinds, driven in to within a few inches of the smoke flues, so as to render them absolutely dangerous from fire. The stone floors in basement—showing unmistakably the dampness of the subsoil—laid on a few inches of bad concrete; the fittings of most inferior character, with broad ledges and sunken tops for the lodgment of dirt and filth; the inside walls and ceilings covered with plaster of such thickness as to invite shrinkage and cracking, the timbering insufficient in strength, so as to cause the floors to shake with the mere walking across them; to say nothing of the trashiness of the so-called internal decoration, in the shape of plaster cornices and centre flowers, all put up to attract the ignorant into a belief that the rooms are well and expensively finished; the drains unventilated, and laid on made-up ground, so that the joints soon become leaky and unsound. The cisterns placed in the darkest and most inaccessible places, so that it is almost impossible to get at them to clean them out; the various lead pipes buried in the plaster-work of the walls, and carried here, there and everywhere, without protection from frost or means of access for examination and repairs. The floors showing wide gaping spaces between each board, owing to unseasoned wood being used, through which dust and filth collect between the ceiling and floor, impossible to clean out, and, I need scarcely say, engendering stuffiness and unhealthiness everywhere.

The unfortunate tenant sees the house carefully painted and papered, and, from want of knowledge, imagines that the house is everything he can wish, and only finds out after he has signed an agreement or lease, the wretched whited sepulchre that he has taken, which, if it be not indeed a means of bringing illness or death to any of his belongings, is a certain cause for continual expenditure in repairs and making good of defective work, which, in taking it, it never occurred to him he would have to pay, thus adding materially to his annual rent, as well as to the general discomfort of every one in the house.

With all the known improvements in house planning, and in the fitting up of the several parts, I marvel much that we are so patient and long-suffering, in being willing to accept the badly planned and badly finished houses, which the speculative builder offers us without regard to, or care for our comfort and healthy enjoyment. The evils are not always obvious until it is too late for us to change, but some few may be mentioned, which should be specially thought of in taking a house; for instance, if a great amount of passage space, with stone flooring to be daily subject to broom and holystone abounds, we want a certain number of hours' work daily out of one servant to keep it clean. If the general fittings are so arranged, that there are inviting places for dust and dirt to accumulate under, and for all manner of filth to lodge above, another servant's time is tolerably taken up, for some hours, in keeping them clean and sweet; or else they are left for the period of the general house cleaning, and thus for months to add to the impurity and unhealthiness of the house. If chimneys smoke and won't draw, there is not only a waste of time in lighting the fires, and re-lighting them, perhaps several times in a day, but a good deal of temper lost; with possible friction between the master or mistress and the maid. If ranges won't burn, or burn too much, and won't heat the water, and will persist in adding to the miseries of the house, by emitting, and—owing to the want of proper arrangement of swing doors and sufficient fresh air and ventilation—perfuming the whole house, at inconvenient hours, with stray whiffs of cooking, or, as is often the case, with whole gales of disagreeable smells of cooking meat or vegetables, the owner or occupier, who may come back weary and worn from a day of worry and hard work in his particular occupation, is inclined to flee the house; to go to his club, in fact, anywhere, rather than submit to the filthy and sickening forerunner of his dinner, which meets him on his crossing the threshold of his house.

How many of us know the nausea and annoyance, which these ante-prandial stenches bring upon us, which, unsubstantial as they are in reality, ofttimes destroy all appetite for the real food, of which these preliminary whiffs and gales are the unpleasant forerunners in so many of our town houses. Or, what is more annoying and unpleasant than to find that, directly the street door is opened, it is like putting the match to a series of small blasting holes in a mine, and one after another, we hear door after door bang, bang, all over the house, and the rattle of small-arms, in the shape of blinds, picture-frames, and other articles, hung on the walls, going off along the whole passage and staircase line, damaging the walls, and irritating our jaded nerves, until the cause of offence is taken away by shutting the street door. Or perhaps after nightfall, when we open the front door, we are met in the face with a great rush of foul and heated air, arising from the gaslight in the hall, where no ventilation exists to modify or do away with this common evil ; or in summer-time, our own or our neighbour's dustbin emits most unfragrant smells, which, coming up from the front area, necessitate all the front windows of the house being closed, and we are thus almost asphyxiated inside with unventilated rooms, or nauseated with the foul stench which finds its way all over the house. And when the dustman, who hails "a hoy" from a distant part of a neighbouring street, like the approach to a strange ship at sea, is brought to an anchor opposite our house, we are forced to give him a fee or a drink before he will empty our dustbin, as he says it has got some refuse or other in it, which the dust contractor is not bound to remove, and he will not do it without the usual blackmail. Or perhaps the cook or housekeeper informs us in the blandest way, that the scullery drain is stopped up, that "she is quite sure that the maid has done nothing at all to cause it," and when we have it opened up, as the builder has not thought it necessary to put in any grease trap, we find the pipe furred and foul, with rancid filth enough to breed a whole hospital-full of ailments.

Or again, we are hospitably inclined perhaps, and invite our friends to dinner, or the modern crush called an "at Home," and our rooms soon become so hot and suffocating, for want of proper ventilation, that they are almost unbearable, and we and our guests get nausea and headache, or if the windows be opened, worse still, cold and neuralgia.

To avoid all this it is essential that pure fresh air shall be introduced and distributed over the rooms, to take the place of that which necessarily becomes foul and tainted, by fumes of cooked meats, gas, and the straining of the cubical contents of air supply by a larger amount of people than usual using the room. If there be no means of providing fresh air, and no means of extracting foul air, it follows that in a very short time, the good air, originally contained in the room, will become tainted, and after a time heated and foul, as the only ordinary means of obviating these evils, are by opening the doors or windows for fresh air inlet, and of trusting to the fireplace opening for extracting a certain amount of foul air, which, remember, is always drawn down in waves over our heads, and is more or less breathed, in its passage to the fire-pump, by every one in the room.

Stand on a chair in an ordinary London room, about an hour after the room has been lit up, and the dinner commenced, and you will then obtain for yourselves some practical knowledge of the suffocating and foul nature of the upper stratum of air in the room, and will not wonder that faintness, nausea, and headache, are often necessary portions of a dinner-party in an improperly ventilated room.

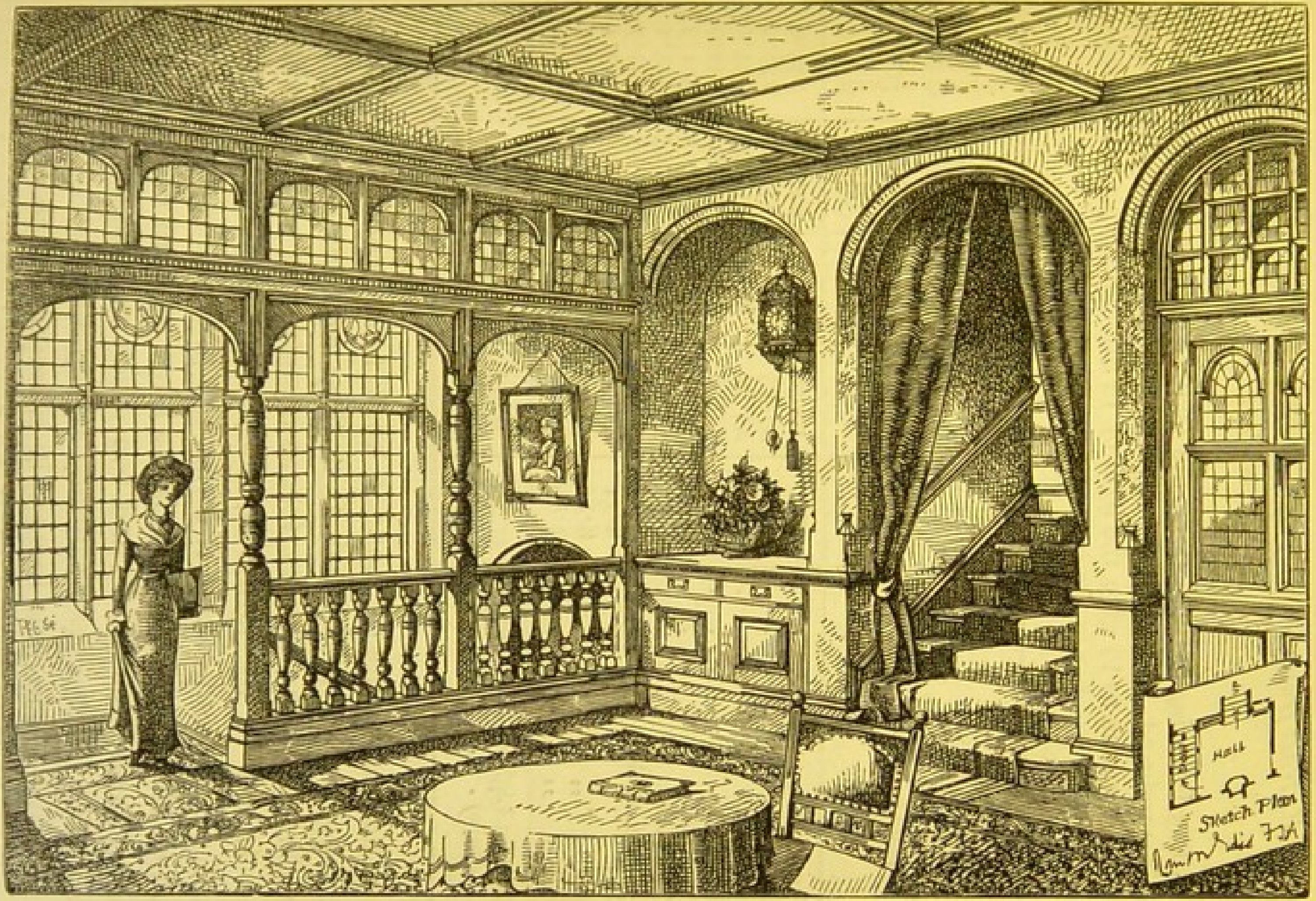
All this can be obviated to a large extent, if not absolutely cured, by providing in, say, each corner of the room, a tube adjusted, in proportion to the size and height of the room, for the access of fresh air through gratings from the outside wall: and the current and amount of air injected, so to speak, into the room, can be easily adjusted by an ordinary butterfly valve, and all dust and soot, and other impurities kept back by a piece of fine silk or wet sponge. These tubes are often put in much too small, and the size of the outside grating is not considered; in all cases the size of the tube should be proportioned to the cubical contents of the rooms, and the external grating should be practically twice the area of the mouth of the tube, as the ironwork of the grating, as a rule, diminishes its usefulness in ventilating area by about half.

If it be not possible to arrange for an extract shaft in the ceiling, a large-sized ventilator may be put in the flue over the fireplace, provided always it be fitted with talc flaps, such as Boyle's, to prevent all back draught; but even the introduction of fresh air alone, by some such means as those I have named, will make a difference in a few minutes of many degrees in the temperature of the room. In large rooms this fresh air may be brought over hot-water coils, fitted as seats in the window openings and controlled by proper regulating valves ; but some simple system of ventilation is essential in every room, if health and bodily comfort are to be considered, more especially in rooms which are lighted by gas, and where, as a necessary consequence, the air is soon made heated and foul : the fresh air inlets or tubes may be so arranged as to form part of the decorative treatment of the room, placed on either side of the window architraves or in the angles, so as to distribute the air as far as possible over the whole breathing surface.

In the hall it is essential to have proper ventilation. If the screen or inner hall doors are shut, as a rule, the air becomes vitiated and heated by the gas lights, and the staircase and passages are fed with foul instead of fresh air.

It is essential therefore that a proper supply of fresh air should be brought in, independent of the door, and this can be done by means of a proper ventilating grate, or if there is no fireplace, by a simple ventilating letter-box, or by some such arrangement as that which I have suggested ; in fact, in every room throughout the house, fresh air should be brought in, either warmed over hot-water coils, or direct through tubes communicating with the outside ; or through some of the best of the now numerous ventilating grates, which are made, so as to feed the house and to mix with and counteract the evils caused by overcrowding, or by the products of combustion of gas or oil lamps.

It is a matter of regret that the various Electric Lighting Companies, who have obtained provisional orders for lighting various districts in London, have as yet made but little progress ; for, as the following extract will show, the benefit to the public will be enormous, as regards the healthiness of their houses, when electric lighting can be substituted for the present unhealthy system of gas, oil, or candles.


Hall
Sketch Plan

SKETCH SHOWING FITTING UP OF SMALL ENTRANCE-HALL.

COMPARATIVE TABLE OF GAS AND OTHER LIGHTS WITH ELECTRIC LIGHT.

Extract from Dr. Meymott Tidy's 'Handbook of Modern Chemistry.'

"The following Table shows the Oxygen consumed, the Carbonic Acid produced, and the Air vitiated, by the combustion of certain bodies burnt so as to give the light of 12 Standard Sperm Candles—each candle burning at the rate of 120 grains per hour" :—

Burnt to give light of 12 candles, equal to 120 grains per hour.	Cubic feet of oxygen consumed.	Cubic feet of air consumed.	Cubic feet of carbonic acid CO_2 produced.	Cubic feet of air vitiated (that is CO_2 = about 1 per cent.).	Heat produced in lbs. of water raised 10° F.
Cannel Gas	3·30	16·50	2·01	217·50	195·0
Common Gas	5·45	27·25	3·21	348·25	278·6
Sperm Oil	4·75	23·75	3·33	356·75	233·5
Benzole	4·46	22·30	3·54	376·30	232·6
Paraffine	6·81	34·05	4·50	484·05	361·9
Camphine	6·65	33·25	4·77	510·25	325·1
Sperm Candles	7·57	37·85	5·77	614·85	351·7
Wax ,, ...	8·41	42·05	5·90	632·25	383·1
Stearic ,, ...	8·82	44·10	6·25	669·10	374·7
Tallow ,, ...	12·00	60·00	8·73	933·00	505·4
Electric Light (Incandescent Lamps)	None.	None.	None.	None.	13·2

The basements of London houses are generally so badly arranged and ventilated, that they add materially to the stuffiness of the houses, for, as a matter of course, all foul air is apt to fly upwards, and, if the basement be foul, heated, and unhealthy, it forms the practical reservoir from which the whole house derives a large amount of its general temperature and tone, and too much care cannot therefore be taken in its proper sanitary arrangement.

Above all, in new houses, it is important that the whole surface of the ground shall be covered with concrete, and that proper damp courses shall be inserted in the walls to keep down all damp, with air bricks for ventilation under all wood floors. The basements should be, in every sense kept dry and sweet, and all passage floors made absolutely damp proof; and the latter can best be done by putting down Portland cement concrete six or eight inches thick, finished off to a fair surface so as to form an even floor, and not, as is so often done, finished with a thin layer or covering of finer cement over the concrete bed, which by-and-by is sure to peel off and leave a rugged and uneven floor.

The scullery should, as a rule, form part of the kitchen, where the kitchen is not used for servants' meals and sitting-room, and not be shut off, or, if so, by a low glass screen. It is merely a washing-up place, and should be under the immediate supervision of the cook, and not, as is so often the case, a small, dark, unpleasant, and ill-ventilated hole, in which unpleasant smells are supposed to be allowed.

It should be as fresh and as sweet as any other portion of the basement, and, although used for the washing up and general dirty work of a kitchen, it should not be allowed to remain dirty, or to be a place in which dirty pots, unwashed and greasy plates and vegetable refuse, are left for hours to breed foulness and unhealthiness everywhere.

Line the whole of the scullery walls, and, as far as possible, those of the kitchen also, with glazed tiles, so that there be no absorption and retention of the smells, which must necessarily accrue with the ordinary work of this portion of the house. Bring in fresh air, provide means of extraction of foul, but do not make a pestilential corner, in which all the impurities of the house are to be confined, the smell of which may find its way over the whole house.

I cannot too strongly advocate the finishing of all the walls in a London basement, so far as the working portion of it, together with the passages, are concerned, with glazed tiles; they are cleanly, absolutely non-absorbent, reflect and give light, are easily washed, and tend to make the house sweet and healthy. The pantries and larders should be so arranged that they have continual ingress of fresh air, and should in all cases be lined with glazed tiles or bricks, so that the evils arising from the contents should not be allowed to be absorbed in the distempered walls, and to render them stuffy and unhealthy. They can easily be made fresh by bringing in outside air, by means of external gratings and tubes, and everything should be done to provide a constant draught and sweeping out of the foul air, which is naturally engendered by hanging game and un-cooked meat. The shelves should be of slate, or better still, of polished marble, so as to be absolutely non-absorbent and easily cleaned.

As in all town houses where space is limited, a large portion of the back offices derive their light and air from the small enclosed areas at the back, it is of the utmost importance that these areas should be lined with glazed bricks to keep them as light and as sweet as possible, and as the air at the bottom is likely to become stagnant and vitiated, a direct current should be ensured up all these small light areas, by means of a large inlet shaft built under the basement floor from the front area, so as to provide for constant circulation and change of air. This can be done at a very trifling cost, as the shaft may be formed of, say, glazed drain pipes, 18 inches diameter, covered at each end with large open gratings, made to lift up so that the shaft may occasionally be cleaned out.

I have dwelt at some length on the more constructural arrangements of the house in the way of ventilation and permanent wall covering, as it seems to me they are essential elements to be considered in every house for its proper healthy fitting up, and should be quite as much considered in the building of new, as well as in the alteration of old houses, as the questions of decoration and furnishing; the first cost may perhaps be considerable, but it will save considerable annual expense in cleaning down and re-papering or distempering of the wall surfaces, while adding materially to the comfort and healthiness of the whole building.

In every basement a comfortable room for servants should be provided: some small sitting-room fitted up with book shelves and cupboards, and, if possible, facing the street, so that the workers of the house may have some sort of spare room, in which they may be at rest from their ordinary duties ; for, if we want good servants, we must treat them as ordinary beings like ourselves, and it is hardly fair to leave them for all hours in the heated and not always pleasant atmosphere of the working rooms.

I cannot too strongly insist upon the necessity of making those about us as comfortable as possible, for I am quite sure that if we provide comfort and health for them, they will be much more capable of doing their daily work fairly, and acting well by us. Remember always, that a large proportion of their lives is spent absolutely underground, and that it is essential that they should have at least one room which shall be cheerful, well ventilated, and as pleasant as we can make it. Let us put ourselves in their places, and do as we would be done by, and so far as my experience teaches me, I am morally certain that the master or mistress, who treats his servants as he would treat his equals, by providing well-ventilated and well-lighted apartments for them to live and sleep in, will be more certain of keeping good servants, and of obtaining good work from them. If they are to be mewed up in ill-ventilated, uncomfortable, and unhealthy chambers for the greater part of their daily lives, we can hardly expect their work to be properly done : the atmosphere in which they live will enervate them, and bring on lassitude, and ennui, which will absolutely make them comparatively useless.

But after all, every man's house is his castle, and all these views of mine as to art, science, and sanitation may be worthless : the glitter and shine of the world, to so many, has more charms than the reality. In the pomp and show of their surroundings, many men pride themselves : their dinners are splendid and luxurious, their reception-rooms are laden with the rich things of the earth, and the show and the glitter express too often the affectation and the imitation of others dwelling in the midst, or on the confines of higher ranges of society, and in all else there is little care or thought.

As Emerson says truly in one of his essays : "Take off all the roofs from street to street, and we shall seldom find the Temple of any higher God than prudence. The progress of domestic living has been in cleanliness, in ventilation, in health, in decorum, in countless means and acts of comfort, in the concentration of all the utilities of every clime in each house. * * * The houses of the rich are confectioners' shops, where we get sweetmeats and wine: the houses of the poor are imitations of these to the extent of their ability."

Avoid all such imitations; let our houses be fitted for every-day wants, for every-day requirements; let them above all be clean, be comfortable, be healthy. Let there be no unfound skeletons, no tangles that are not unravelled; open up the doors, let light and air in upon the skeletons; search them out, make the houses we live in pure from end to end, and depend upon it, we shall have less disease of mind or body.

Remember always that the healthiness, the comfort, and the pleasant and artistic arrangement of our houses, means the healthiness, the teaching, and the bodily and mental health of our children. The seeds of illness may be sown broadcast in our children, and the life may fail when we should be garnering the fruit.

Let me close this portion of my subject by a quotation from Dr. Richardson's eloquent opening address at the Brighton Health Congress, in 1881, on "the Seed-time of Health:" "By a few rules, in short, which all prudent and wise people may carry out in their own houses, the accidental perils of the seed-time may be kept from the homestead as easily as from the prison house. Let every man and wife be their own Sanitarians, and make their house a centre of sanitation: let in the sun, keep out the damp: separate the house from the earth beneath: connect the house with the air above. Once, nay twice, a year, hold the Jewish passover, and allow no leaven of disease to remain in any corner or crevice: let the house cleanse itself of all impurities as they are produced, and all the good that science can render you is at your absolute command."

CHAPTER II.

Present bad system of leasehold tenure—Diseases attributable to badly built and fitted houses—Sanitary decoration—Healthy treatment of floor and wall surfaces—Influence of colour on the optic nerves—Paperhangings—Washable papers—Unhealthiness of stuff hangings.

THE present iniquitous and unjust system of leasehold tenure is, in my opinion, one of the chief causes of much bad building, and naturally tends to prevent any ordinary tenant from expending any larger sum than he can help in general constructive decoration, or in the sanitary fitting up of the house, of which the landlord practically reaps the benefit, without, as a rule, contributing a farthing to the cost, while, in addition, at the end of the term of the lease, under the present law, he can claim for dilapidations, which in nine cases out of ten have arisen from the original inferiority of the building in construction, sanitation, and healthy decoration and finishing; such manifest incongruities and unfair anomalies must, I imagine, be ere long done away with. The common sense of the people, their necessities and requirements, based on higher knowledge and greater desire to have the individual houses put in order, and arranged, so that each house may, in itself, form an integral portion of a well-arranged and sanitarily constructed whole, by which the individual and the community will be equally benefitted, will, by and by, insist on a new order of things, so that the monopoly of sites in crowded towns shall not be vested in the hands of a few individuals, without the lessees having the right of the equitable redemption of the ground rentals, whereby, at least, the buildings, on which they have spent enormous sums of money, shall remain theirs for ever, by payment of such sums which may fairly be demanded for their enfranchisement.

If our towns are to be reconstructed and added to, on healthy and proper principles, each house must be properly constructed, and certain fixed rules insisted upon, as regards proper general health arrangement and sanitation; for "the same rule," to quote Dr. Richardson, "applies to the accumulation of health as to the accumulation of wealth." 'Take care of the pennies,' says the Financier, 'the pounds will take care of themselves.' 'Take care of the houses,' says the Sanitarian, 'the towns will take care of themselves.'" It follows therefore that so far as common-sense laws can be applied to the rebuilding of the houses of closely packed communities, they should be on some general and uniform system, where the laws of health are concerned, which all must follow; but this only applies to sanitation; so far as general arrangement of rooms is concerned, the wants of the individual must necessarily be consulted, and with regard to the mere artistic improvement of our towns, I am strongly of opinion that the greater the variety of design, the greater will be the artistic character and general picturesqueness of our streets.

We do not want whole rows of houses which, in bad sham-plaster decoration, shall imitate the feeble monotony of the Rue de Rivoli in Paris, or which shall, by the censorship of some body of specialists or local official, crowd our cities and towns with pseudo-Italian Palaces or Gothic Town-halls, as ill-suited to our climate, as they are opposed to all true principles of common-sense, modern construction, and design.

To sacrifice internal comfort, light, and ventilation to some special order of fenestration, Greek, Roman, or Italian, or to the cramped and narrow lines of a mediæval fortress or building of bygone ages, seems to me to convey nothing but poverty of thought, or narrow-minded conventionalism, equally opposed to all true principles of architecture as it is to the wants and requirements of the people of the nineteenth century.

Comfort and convenience of arrangement, ample light and ventilation everywhere; protection from damp and miasma, impure and unhealthy smells; warmth, freedom from draught, pure air, pure water, general cleanliness, and attention to all known laws of sanitation, are first of all to be considered in every house.

I have lately been reading a powerfully written article by Dr. Richardson, on "Health in the Home,"* in which he sets forth in vigorous, but not exaggerated language, the various communicable diseases which are "promoted, or introduced, by the errors of construction in the dwellings of our communities," and I have been much struck by the number of preventable ills which he associates with either bad ventilation, damp, bad drainage, impure water supplies, want of light, and through draught; uncleanliness and foulness or stuffiness of modern dwellings, owing, to a large extent, to unhealthy decoration and furniture; and as, in the course of my suggestions, I shall have occasion to specially allude to the means by which all these evils may be at least ameliorated, if not got rid of altogether, I quote some of his remarks, for I cannot too strongly insist that the treatment of the decoration and fitting up of the houses we live in, must be first of all considered from a general health point of view, and common-sense treatment of plan, design, and fittings, rather than from any mere personal opinion, so far as regards particular types of style or architecture to be adopted in internal planning, or external design.

To begin with, Typhus, Typhoid, Relapsing, and Scarlet fevers, are mainly due to foul air, impure smells or water, or closely packed and unventilated rooms, while the poisons thrown of by these diseases, are retained in the walls and flooring, if badly constructed; impure air, arising from dust and dirt accumulations, and bad sanitation, tends to other illnesses in a minor degree, such as dyspepsia, nervousness, and depression, "during the presence of which conditions," to quote Dr. Richardson, "a person is neither well nor ill." Another of our most fatal English diseases, "pulmonary consumption, or consumption of the lungs, has been largely promoted by the presence of unchanged and impure air in the dwelling-house;" while "neuralgic and miasmatic diseases" are brought about by the same causes, assisted by "atmospheric moisture or damp, so often to be found in houses built either upon clay, or in moist situations, where the ordinary precaution of covering the whole surface area with concrete, or some other damp preventive, has not been carried out."

---

* 'Our Homes, and how to make them Healthy,' Cassell & Co., Limited, London, Paris, and New York, 1883.

Dampness, which is so often to be found in the basements of town houses, in conjunction with impurity of air, brought about by bad ventilation or imperfect sanitary arrangements, or general closeness and stuffiness of rooms, in which dirt and dust are perforce allowed to accumulate, are more or less directly the causes of all the malarious diseases —"ague, neuralgia, and rheumatism"—and here the speculative builder comes in with venom, certain and incurable; with soft spongy bricks, which absorb a large amount of moisture; with mortar composed of road-drift or scrapings, foul and unhealthy; with damp and unseasoned timber, ingredients in the plague-spots, which warmth of fires bring out in vapour, and wherein moisture seems ever present, dimming the mirrors or condensing on painted walls, or absorbed in paper or distemper, which on every damp day becomes a visible barometer, marking plainly the change of temperature.

In all houses of the class I have referred to, it is desirable to counteract as far as possible the deleterious influences which are brought about by the absorption of offensive odours in the common deal floors of the various rooms, by having all the joints carefully stopped in, and the whole surface painted over three or four coats, so that the pores of the wood may be effectually closed, and the crevices, through which dirt and filth of all kinds may enter, and lodge in the spaces between floor and ceiling, practically sealed up. Or the floors may be stained and varnished all over, for varnish of the cheapest kind, whether made with resin in place of hard gums, or petroleum in place of turps, is not only healthy in its application, but cleanly and economical, as it can be readily cleaned of all impurities by a wet cloth, and lasts longer than a mere painted surface, if done properly at the onset, and every coat left to dry and become thoroughly hard before a second coat is put on. Good varnish will dry and be free from all stickiness in one or two days, if the general atmosphere is free from damp.

In badly constructed and ill-arranged houses, how often do we hear the inhabitants complain of what is technically called "draught," which means sudden and irregular change of temperature. Unpleasant as it is in itself, it is most insidious and dangerous in its results, bringing about colds, chills, and general "disturbance in the circulation of the organs of the body."

It is unnecessary to dwell further upon the numerous ills which we have it in our power to lessen or altogether get rid of, by attention to the general construction of the houses we live in. I can only insist generally, with Dr. Richardson, that "the intention and object of domestic sanitation, is so to construct houses for human beings, or if the houses be constructed, so to improve them, that the various diseases and ailments incident to bad construction of every kind, may be removed to the fullest possible extent. The diseases need not to be looked upon as necessities of existence, but may be recognised as results of ignorance, or as accidents, which, though they may not spring from sheer and wanton ignorance, are removable by accurate foreseeing, and all-providing knowledge."

The proper sanitary arrangement of the house so far as drainage and pure water are concerned, is now more or less provided for by the various Acts of Parliment which have been passed within the last ten or fifteen years, and by the increased knowledge of individuals as to the risk and danger incurred by leaving these important matters unattended to. Most common-sense people insist, when taking a house, on the drainage being thoroughly examined and set right ; but many altogether lose sight of the equally important question of sanitation, so far as ventilation, the common-sense and healthy treatment of the wall and floor surfaces, and the general decoration and furnishing are concerned. Many of us are still content to trust to the ordinary fireplace and window openings for the ventilation of the rooms; to shut out light and sun by means of Venetian blinds, on which blacks and dust cannot fail to rest; or with heavy curtains and draped valances, which add so materially to the stuffiness of the room, by collecting dust and dirt, and by retaining all the impurities of bad air and foul smells, which must obtain in all improperly ventilated apartments. Many people are still content to cover the floor spaces all over with thick carpets under which fluff and dirt must of necessity accumulate, without chance of being got rid of, except at the annual or biennial periods of general cleaning. We have covered our walls with heavy flock papers, or stuff hangings, to collect dust and absorb all sorts of foul and unhealthy vapours, or with those absolutely poisonous in their colouring-matter, or incongruous and unharmonious in their design, acting, perhaps imperceptibly, more or less prejudicially upon our nerves, and with jarring and unpleasant effect in times of sickness and sleeplessness. We have filled our bedrooms with heavy and lumbering pieces of furniture, under which, and on the top of which, dust and filth are allowed to collect, and to remain, to the manifest unhealthiness of the room, and without thought of the evils which must be associated with anything which in any way helps to the stuffiness and impurity of the rooms, by retaining dust or dirt, or in absorbing and retaining the various impurities which must necessarily prevail in rooms which are more or less closely shut up at night, and in which there is no proper arrangement for the ingress of pure, or the egress of foul air.

To a certain extent all this unhealthy decoration and furniture is as detrimental to our bodily and mental well-being, as bad drainage or impure water, and in times of sickness, by retaining all the bad effluvium and infection, necessarily assists in the spreading of any disease, while adding always to the general unhealthiness of the house.

"It must be evident to common-sense people, that all furniture which collects and holds dust and dirt, which cannot be easily detected and cleaned; that all window valances and heavy stuff curtains with heavy fringes, which cannot be constantly shaken; and that all floor coverings which are fastened down, so that it is impossible to clear away the dust, that gradually, but surely, finds its way under them, and prevents the coverings themselves from being constantly shaken, are objectionable and unhealthy.

"In the present craving after artistic decoration and furniture, and improved sanitary arrangements, it may be that we are running to the other extreme, frightening ourselves unnecessarily, and by overdoing the remedies which are recommended and provided for us by all the various experts in sanitary science or art decoration, inflicting damage, which, by more careful thought and intimate knowledge of the why and the wherefore such remedies are to be applied, we might well avoid.

"All new doctrines are, however, liable to be carried to extremes, and it is only by real knowledge and experience of years that we can hope to arrive at that happy medium, in which the true shall be separated from the false, the wise from the foolish. Whether it be in the adaptation of art or science for the improvement of our dwellings, we can hardly expect after so many years of utter disregard of the first principles of truth and fitness in all construction, sanitary and artistic, to begin an age of improvement, and real progress, without falling into some of the many pitfalls which the various professors of the new schools of sanitary and artistic improvement naturally lead us to, when as yet they are not agreed themselves on the best principles or means for carrying out the especial theories which they advocate."

"Pet schemes are like pet dogs, nuisances to be avoided as much as possible; and common sense should, I take it, enter largely into all matters that are to be permanently useful to mankind, whether it be in sanitary appliances for the better drainage and water supply, or in the more healthy and truthful decoration of the houses we live in.

"It may be said that the two things are not capable of comparison; that science depends only upon facts, and the results of much experience, and many failures, while decoration is a matter of taste, made up of many theories and dependent, to a great extent, on the individual fancy and caprice, or upon the amount of knowledge or ignorance, as the case may be, either in the individual or the artist.

"It would be easy enough to combat this argument, by pointing out that there are almost as many opinions, differing to a large degree, in questions of sanitary science, as in those pertaining to truth and taste in decoration; various sanitary professors will tell you that 'traps' are deadly, while others will assert that you cannot 'trap' too much. The professors of artistic decoration differ materially in their views, and are not yet agreed on the, to my mind, fundamental principle, that all good decoration should be truthful, and based on construction; that all things should be beautiful in form and colour, whatever that form or colour may be. Whatever may be our own particular fancies or caprices as to form and colour, the one should be essentially fitting for its purpose, graceful in its treatment, and truthful in its construction; while the other should be harmonious and pleasing, without any flaunting crudities or vulgarities which, to the really educated or refined mind, are as objectionable, and, in their way, as morally and mentally, if not bodily deleterious, as any other impurities or imperfections with which we may be surrounded. Most common-sense people, however, nowadays can glean from the mass of theories, innumerable facts which may be useful aids to the more healthy, as well as more artistic treatment of their homes. They will probably avoid all wall coverings which offer resting-places for dirt—such as the high-relief flock patterns, which, however good artistically, are certainly to be avoided on sanitary grounds;—will not cover the whole of the floor surfaces with thick carpets, which absorb and retain dust and disease germs, and which cannot be easily removed and cleaned, or shaken, at least once a month; will do away with all heavy window-curtains and valances, which, in small rooms, add so materially to their stuffiness and unhealthiness; and will, as far as practicable, avoid filling their rooms with heavy lumbering furniture, which cannot easily be moved for cleaning purposes, and under and above which dust and other impurities may collect and remain.

"As a first principle in all true decoration, it must always be borne in mind that good ornament should invariably be associated with, and form an integral part of, the real construction of the building. If this principle were always understood and adhered to, the cost of the generally trashy composition and plaster work with which the ordinary builder has thought it necessary to overlay the walls and ceilings of our houses would be considerably reduced; all this overlaying of sham constructive ornament is not only bad in taste and expensive, but oftentimes a source of danger, and always an element of dirt in our rooms. What can be more hideous and more useless than the elaborate plaster or papier-mache cornices, which are generally to be found in every modern house, in which long lines of recessed mouldings, and trumpery cast enrichments of the worst possible design, answer no practical purpose, and serve only as recesses and resting-places for dirt and dust? while the elaborate and vulgar centre flowers and corners, which are stuck on to so many of our ceilings, are so far an element of danger that they add materially to the thickness of the plaster-work, and being altogether false in construction are liable to give way and fall down at any moment, in themselves are entirely opposed to any true principles of decoration, and if picked out in various colours, according to the fashion usually followed by the general run of decorators, are eyesores in the room, and in every way objectionable and out of place. Simple plain mouldings, or hollows, to take off the stiffness of the square break between the walls and ceilings, are all that are necessary, without enrichment or stuck-on ornament of any kind. These breaks can then be treated in a quiet and simple manner, and help to improve the general decorative effect of the rooms, whether they be papered, painted, or distempered.

"From every point of view these constructional shams are objectionable. They weary the eye with their long monotonous multiplication of the same moulded truss, leaf, or flower; they are essentially false and untruthful, and so far are opposing elements to the association of fitness and reality, which are so eminently desirable in everything around us; they are conducive of dirt and dust wherever they occur, and must naturally thus add to the stuffiness and unhealthiness of the room, while at the same time they are opposed to all true taste and artistic beauty and simplicity, in the decorative ornamentation of our walls and ceilings. In objecting to all such constructional shams as these, I am anxious that it should be understood that I do so, not only upon the point of taste, but on the more substantial basis, that they are, to a great extent, elements of useless expense, and tend to deaden the mind to an unhealthy and careless disregard of false art and construction, and so far to prevent any better feeling for true taste in decoration."

If the cornices of the rooms be deeply recessed and filled with heavy plaster ornaments, they must of necessity hold dust and other impurities, which are increased by the action of damp air causing decomposition, and by mixing with the air in the room, when stirred or blown away from their resting-places by draught from opened door or window, must render it impure and unhealthy. In addition to this, they are more or less choked up by every coat of so-called distemper decoration, and this again, by absorbing damp and obnoxious exhalations, adds materially to the sense of stuffiness and foulness which can be appreciably felt on first opening up the room after it has been closed for some hours. It is better, if possible, to paint all ceilings and cornices than to distemper them, so as to render them as non-absorbent as possible; by painting, the plaster-work is covered with a non-absorbent coating, on which if desired a coat of distemper may afterwards be added.

Shams of all kinds are to be objected to; they are generally false in construction, always, as a rule, unnecessary elements in the design whether in decoration or furniture, and frequently elements of danger, more especially when they consist of heavy plaster trusses under door or window heads; or in thick composition ornament in ceiling decoration, or in mere stuck-on cement enrichment to external or internal cornices; nor can I see what beauty there is in graining or marbling wood or plaster work in imitation of the real materials. "What can possibly be worse in taste and so utterly cold and miserable as covering staircases or other walls with paint or paper, in imitation of blocks of marble or granite?" Walls thus treated have a trumpery appearance, while the monotonous effect of the long rows of lines, vertical and upright, is as disagreeable to the eye as it is unartistic and commonplace. What can be more trashy than graining the outside of a door with dark walnut or wainscot, while the other side is treated as satinwood or maple? And after all, when this is done, it is a miserable travestie of the real materials, and deceives no one who really knows anything of the particular materials the graining is intended to represent."

This I may be told is an argument in its favour, that it deceives no one, and therefore does not matter; but the intention is the same, and whether the lie be well or badly told, it is a lie any way, and so far subversive of a healthy turn of mind or true artistic feeling.

As a rule it is desirable as far as possible not to disturb the general flatness of wall surfaces, and to avoid all patterns which obtrude themselves too prominently upon the eye, or cause the space, whether covered with paper or painted decoration, to be broken into groups of ornament, or into distinct lines cutting it transversely or horizontally. The wall surface may be divided either by a chair or frieze rail and be treated in different shades of colour with good effect; or the upper portion may be covered with good artistic painting, which will add to the beauty and picturesqueness of the room. Where the upper space is covered with paper or distemper, the pattern or colouring should offer no startling contrasts, and the lower portion may be painted and varnished, so as to be readily cleaned. The colour of the wall surfaces of the different rooms must naturally depend upon the purposes for which the rooms are used, as the apparent warmth and pleasurable appearance of the room is materially enhanced or detracted from by the treatment of the wall-colouring ; and while it is necessary to treat the surface of one room as a background for pictures, it may be desired to have another brighter and more decorative ; but wherever possible, in passages, halls and staircases, it is desirable to varnish as much of the wall surface as possible, so as to render it non-absorbent and readily cleaned.

"I believe it has been shown by experiment and observation, that, to a certain and distinctly appreciable degree, various colours act upon our optic nerves to their fatigue and injury, and so far to the weariness and unhealthy action upon the brain, and that therefore it is a matter of interest to us how far we may choose colours which present an harmonious and pleasant contrast to the eye, or which fatigue and annoy us by their harshness and inharmonious arrangement. Quite certain it is, however, that proper and harmonious contrast and arrangement of colours is an important question in all artistic decoration, as by proper contrast various colours may be made to look more beautiful and effective, while a dingy and unpleasant effect may be easily produced by any bad or violent combination ; and, as a natural consequence, the graceful and pleasant appearance of our rooms will be naturally enhanced or decreased by a study and knowledge of the contrasts and effects of various colours. Without being able to define the exact shade, and even sometimes the exact colouring of any room we enter, we are sensibly affected, pleasurably, or the reverse, by its general tone and treatment ; even as in admiring good taste in dress we may not always be able to describe what it was that caused our special delight or admiration." The strength and depth of colouring of a wall surface must be also considered in the relative sizes of the various rooms; and tints, which may be charming in themselves, are sometimes rendered positively unpleasant by their strength or depth, while others, which are charming in polished surfaces or in folded drapery, become cold and dull on a flat wall; while colours that in themselves are harsh if carried all over the surface in one general tint, are made pleasant by gradation in tone, or by the contrast of some bright piece of decoration, no matter how small or simple it may be. The prettiness and general pleasant effect of a room is often marred by some injudicious or inharmonious contrast of colouring or design in the paper or decoration, and ornament that should be in subjection and subordinate to the general effect is made staring and obtrusive, to the destruction of the artistic effect, and to our own mental annoyance. Without further entering into the physiological causes, which enable us to judge between the proper and pleasant contrast and association of colours, and the reverse, it will, I think, be admitted that a greater regard and attention to house decoration will pleasurably or prejudicially influence our own comfort and health, and if this be admitted when our bodily health is good, and our nerves strong and vigorous, how much more will it be admitted when suffering from bodily or mental ill-health and fatigue?

Whether it be in paint, paper, or distemper decoration in the covering of wall surfaces, it is quite certain, as the late Mr. Owen Jones says, in his 'Grammar of Ornament,' that as regards colour, "The secret of success is the production of a broad general effect by the repetition of a few simple elements; variety being sought rather in the arrangement of several portions of the design than in the multiplication of varied forms." When emerald green or bluish green enters into a combination, the effect is harsh when the green covers any large amount of space; green in itself is a cold colour, while yellow conveys the feeling of light, and red that of warmth: a yellow paper with ornament well defined, like some of the old Italian brocades, makes a charming wall covering for a hall passage or staircase, while nearly all tones of red which have no violet tones are good backgrounds for pictures or prints. Professor Rood, in his valuable treatise on Modern 'Chromatics,' speaks of "blue violet or artificial marine blue" as making "cold and hard combinations," while "large surfaces of it are apt to appear disagreeable if the hue is at all intense."

"In the selection of paper or other hangings, and in the arrangement of all ornament in wall or panel decoration, it becomes therefore a matter of importance to select none which shall have distinct and strongly marked patterns, in which the ornament stands out and repeats itself in endless multiplication and monotony. All such patterns would be a source of infinite torture and annoyance in times of sickness and sleeplessness, would materially add to our discomfort and nervous irritability, and after a time have a ghastly and nightmare effect upon the brain."

All staring patterns should be avoided, and all of those French papers in which a moiré silk ground is seemingly covered in blotches with bunches of gilt or naturally coloured flowers, their monotonous repetition annoys and distracts, while the general effect is anything but artistic or good. Within the last few years a great improvement has been made in the manufacture of all wall-papers, from a mere hygienic point of view, both in the cheap machine-printed, as well as the more costly hand-printed examples. Almost all papers may now be considered practically free from arsenic; and I believe I am correct in asserting, that the largest printers of machine-printed papers now use little or no arsenical colours; whereas a few years ago, I am informed, that one house alone used some tons of arsenical green per month in the manufacture of their goods. The principal manufacturers of block-printed papers allow no colours with a known trace of arsenic to enter their factories; and, as the colours of this class of paper-hangings are more thoroughly bound with size than those which are machine-made, they are to be recommended for house decoration in preference to the cheaper kinds, as being to a certain extent more lasting.

It is an error to suppose that bright green papers alone contained arsenic in their colouring matter; blue, red, brown, and the pretty French greys, used formerly to be almost as much impregnated with this hurtful compound; and it is a subject of congratulation that, as a rule, the use of arsenic, as a colouring matter in wall hangings, is practically done away with; for nothing can be more prejudicial to health than the use of this virulent poison, in no matter how slight a degree, in the wall coverings of our rooms.

Notwithstanding, I believe, innumerable attempts on the part of various manufacturers, no paper has been yet produced which, without being varnished, could be made entirely non-absorbent and washable; but in the present Health Exhibition one of the principal firms of paper manufacturers in London exhibits a collection of what they call "Patent Hygienic Papers," which are treated with a solution which renders them washable and non-absorbent, without giving gloss to the surface, and without any appreciable damage to the colouring. These papers I am informed have been tested, and have been proved by experiments to be practically impervious to the general impurities thrown off by gas and crowded rooms, and will naturally commend themselves, from a sanitary point of view, for the covering of the walls of dining and bedrooms, wherein it is manifestly of importance to cover the wall surfaces with non-absorbent and washable materials. The solution with which these "Hygienic" papers are treated can be applied to all classes of paper-hangings, and will thus act as a protection to those in which gold is used, and to prevent the flaking off of the small particles of talc which is used in some of the modern "silk" papers.

I do not see why, therefore, all paper-hangings of the cheapest, as well as the more expensive varieties, in the shape of stamped leather, and elaborate block-printed patterns, should not in future be treated in this manner, by which they will be rendered in every way more lasting, and generally more suitable and healthy for the covering of our walls. It is hardly necessary to dwell at any greater length on paper-hangings, which, after all, must enter largely into the decoration of all the wall surfaces of our houses; but, on all sanitary grounds, I cannot but consider that all flock papers, however beautiful in design, are especially to be avoided, for, from the very nature of their design and treatment, they are detrimental to the healthy treatment of the room. The patterns stand out in relief, and offer innumerable spaces for dust and dirt, while the generally fluffy nature of the material, practically powdered wool, renders it more absorbent and therefore more unhealthy; and the surface holds dust and dirt to a much larger degree than the ordinary printed papers, thus tending to a stuffy and unwholesome feeling, which is essentially at variance with all laws of health and comfort.

Stamped papers, in which the pattern is raised in relief, offer the same objections in a minor degree, as the surface is smooth and can be readily cleansed; and in the case of the imitation leather papers, the surface is varnished, and can be readily gone over with a damp cloth without injury. These papers can be well used for the dados of rooms or frieze decoration, and as such are exceedingly effective, although, of course, from the very nature of the manufacture, much more expensive than plain painting and varnishing.

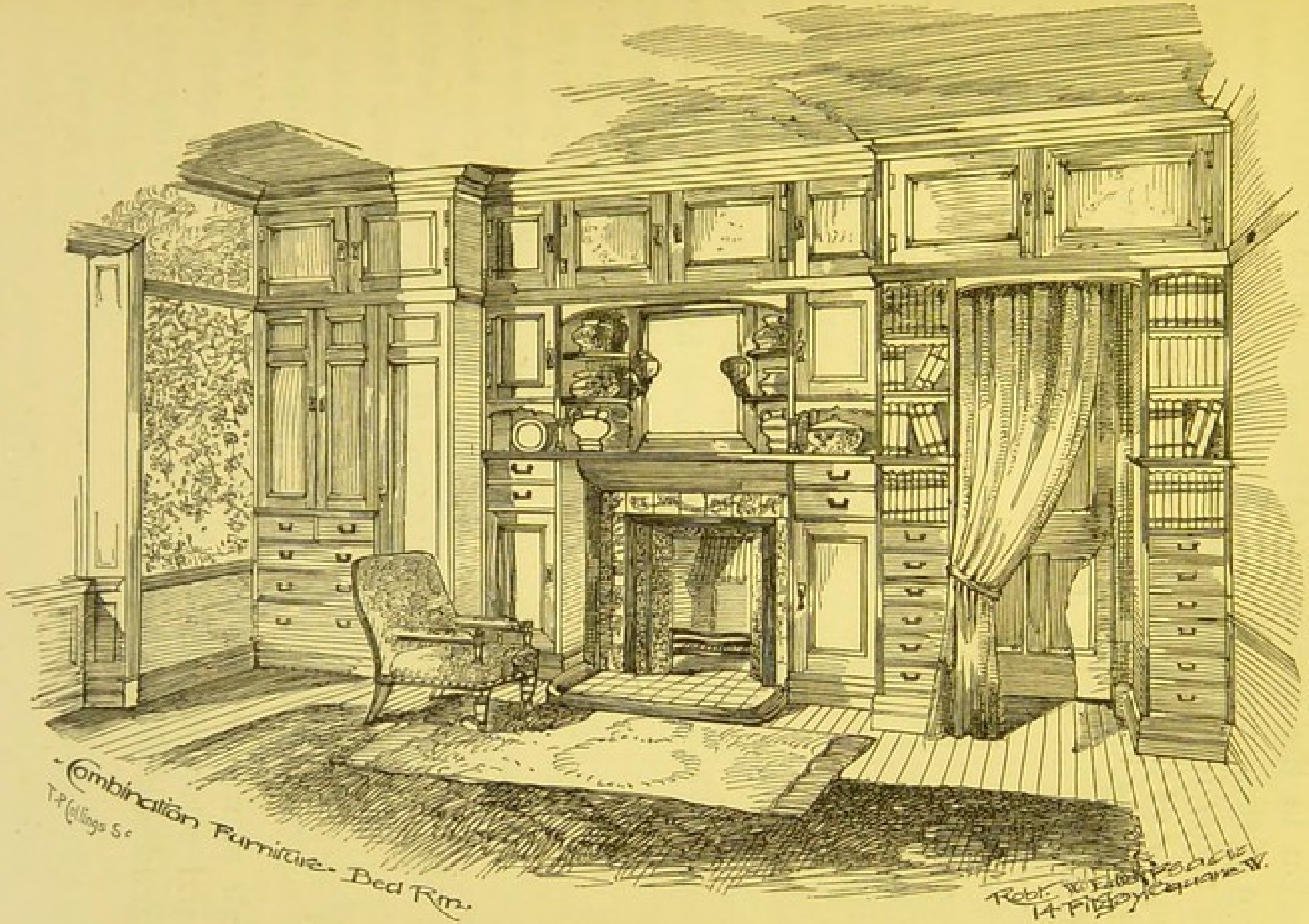
I may here mention that a good deal of illness often arises from the bad nature of the size and paste with which the ordinary wall-papers are hung, and great care should be taken that no such inferior, and practically stinking materials are allowed. A late number of the 'Sanitary Record' gives an extract from a paper by M. Vallin, in the Revue d'Hygiene,' in which an instance is given of the danger of this use of putrid size and paste: "A lady, who from time to time came to supervise the decoration of her houses, was three times successively seized with violent sickness and headache, after sleeping in a newly papered room.

M. Vallin was struck with the putrefactive odour which pervaded the atmosphere, and, after examining into the matter, came to the conclusion that it proceeded from the wall. It was found that a horrible putrefactive odour proceeded from the size-pot with which the paper-hanger in the next room was continuing to hang the wall-papers, and that his size was in a state of putrefactive change. On making further enquiries, various other cases have come under his notice in which illness has palpably been produced by the use, by paper-hangers, of size and paste undergoing, or speedily entering on septic change; and it is extremely desirable that this should be borne in mind, and if necessary, a little oil of cloves, salicilic acid, or some other antiseptic agent should be added to the material which they use for this purpose, or at any rate, care should be taken to avoid those disagreeable consequences of carelessness which is only too common."

How frequently do we notice in a newly papered room this faint and sickening smell, which is not got rid of for a long time after the work is completed, and which by the action of damp or heat is generally increased, adding materially to the foulness and unhealthiness of the room. Whenever this foul odour is noticed, it would be well to insist upon the paper being stripped off entirely and the room re-done, for I do not believe that anything short of this can make the room healthy and fit for occupation. In many instances, more especially in old houses where the plaster surface of the walls is bad and unsound, it is a common custom not to strip off the old paper; but it is hardly necessary for me to point out how requisite, for health's sake, it is that every bit of old paper should be cleaned off the walls, before any new paper is put on; as not only does the paste of the old papering often decompose, and become in itself injurious to health, but each covering of paper only adds to the absorbent nature of the wall surface, and helps to increase, therefore, the unhealthiness and stuffiness of the room.

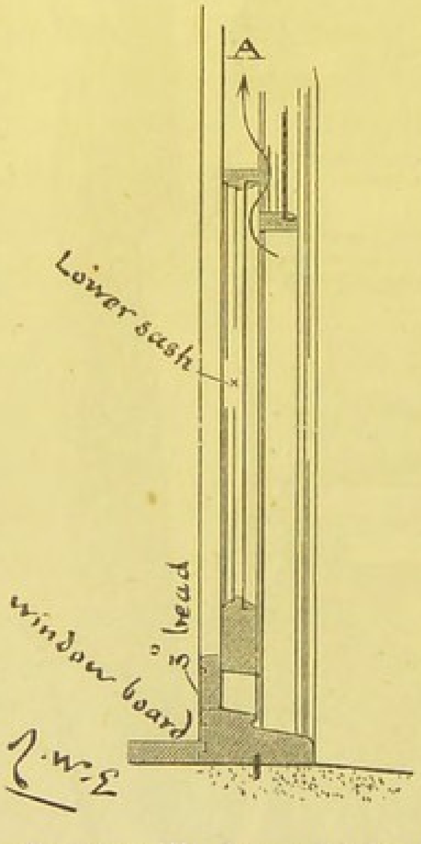
If there be any truth in the assertions that are made, that nausea and general lassitude, not to speak of any severer forms of illness, are engendered by want of attention to the proper healthy arrangement of our homes; and that dirt and dust are to a certain extent equally conducive to the unhealthiness and unwholesomeness of our houses, as defective drainage and bad ventilation; it must be admitted that we have yet much to learn for the more practical and better fitting up of the rooms we live in, and that too much care cannot be exercised in providing that, so far as practicable, all extraneous and useless ornaments and unhealthy fittings shall be avoided. Many people litter their rooms with all kinds of lumber, until there is hardly a corner free from it. They cover their floors and tables with fluffy mats of various kinds, which hold all kinds of dust and dirt, and which, like pitch, you cannot touch without being defiled. With the best of servants and the best of supervision, it is impossible to keep such rooms pure and wholesome. Things stowed away in all sorts of odd corners, wherein they are left undisturbed for months, must breed dirt and disease; and while it is, of course, necessary that in every household there should be storing-places for all sorts of things only required for a season, and then to be stowed away, such kind of storing-places should be made suitable and convenient, so that they can easily be got at and easily cleaned.

While every care should be taken in the selection of the materials with which we cover our walls and floors, and in avoiding as far as possible the shutting out of light and the retention of dust by heavy curtains and by the overcrowding of our rooms with dust-and dirt-holding furniture, it must be borne in mind that all our efforts may be rendered comparatively useless without some proper system of ventilation, for, to quote Captain Galton's little book on 'The Construction of Hospitals': "The purity of the air within an inhabited space enclosed on all sides is necessarily vitiated by the emanations proceeding from the bodies of those who inhabit it, and especially by the effect on it of their respirations. With persons suffering from


Combination Furniture - Bed Rm.
T.P. Collings Sc
Robt. W. Edis Fecit
14 Fitzroy Square W.

SKETCH SHOWING COMBINATION FURNITURE—BED-ROOM.

disease, especially infectious fevers, or from wounds, or sores, those emanations are greater in quantity, and more poisonous in quality than from persons in health. Stagnation in the movement of the air leads to rapid putrefaction of these emanations." Too great care cannot, therefore, be taken in providing some means of ensuring a constant supply of fresh air in the rooms in which we sleep, and which are shut up for a considerable portion of the night. If the suggestions I have offered for the proper and efficient ventilation of the various rooms cannot be carried out, a simple means of providing a certain and constant ingress of fresh air into the rooms, without appreciable draught may be arranged by having the lower bead of the window-frame made, say, three inches deep, so as to permit of the lower sash being raised slightly, as shown in the accompanying sketch, by which a current of air will be drawn in at the point A; or the woodwork of the upper or meeting rail of the lower sash may be cut and fitted with a small adjustable valve to admit fresh air at will, by which the room may be kept fairly pure and sweet during the hours of sleep and rest, and the general healthiness of the atmosphere materially improved.



CHAPTER III.

Constructive Fittings—Arrangement of different rooms—Healthy treatment of walls and fittings—Bedrooms and Nurseries.

In the early portion of this century, to quote Mr. Redgrave, R. A., in his pleasant little book, the 'Manual of Design:' "While our Architects were content to put columns that supported nothing, roofs that covered nothing, and parapets and balustrades that protected nothing; to contrive sham attics to hide the construction of ugly roofs, to make us peep through the scroll-work of a frieze, or the channels of a triglyph instead of a window, or to make the pedestal of a statue into a chimney-pot, how was it likely to fare with furniture which became a sort of toy architecture? Was it to be wondered at that all constructive shams were increased tenfold when used as ornament? Was it surprising that Grecian stone altars formed our sideboards, Roman temples our cabinets, sarcophagi our cellarets, and wine-coolers; or that our harpsichords stood on lyres instead of legs; that constructive truth, in short, was wholly and entirely disregarded in order that some favourite type might be reproduced? Was it to be wondered at, moreover, that men broke loose from these dead shams, and, getting sick of these classicalities, entirely deserted constructive truth and symmetrical arrangement; went mad first after Rococoism, and then, in our own days, after picturesque naturalism, and that the very revolution of taste produced the wildest contradictory faults."

Art in all its branches seemed, at the period to which Mr. Redgrave refers, to have been at the lowest possible ebb, and while the architecture of the day was of the weakest possible type, painting, sculpture, and the various trades or manufactures, which are more or less associated with artistic productions of all kinds, in connection with our home surroundings, were equally bad. The furniture and fitting up of the houses of the present day have perhaps been suggestive of another extreme: luxury and elaboration of design without due regard to comfort, fitness and general use, seem to me much too important elements in the more expensive furniture of the present day; while, as a rule, the healthy treatment of the different pieces seems rarely to be thought of; and by this I mean, that heavy and unwieldy cabinets, wardrobes, and bookcases are constructed with sunken tops, and other equally objectionable features, in which dust and dirt may collect and remain for months, to the manifest unhealthiness of every room in which all such unwieldy furniture is placed; while but little regard is had to the more simple and certainly less costly and infinitely more healthy fitting up of recesses and wall spaces with "fitments," or closets, specially arranged for their respective purposes, and carried down to the floor, and up to the ceilings, so as to present no harbour places for dirt and dust and other impurities.

While I want to see our homes pleasant and artistic; that is to say, with decoration and furniture, good in design and taste, and harmonious in colour, and not overlaid with trashy and unnecessary ornament, or filled with useless and unhealthy lumber: I hold that true art in the house means the practical rendering in good taste and pleasant guise, of all the absolute necessities and requirements of modern life; and all domestic art is bad, which ignores the purposes to which the furniture, decoration, or general belongings of a house are to be put. Comfort, utility, and good sense, should go hand in hand with artistic design in all the internal finishing of every house.

Men take pride in the building of their houses, and spare no pains or expense in seeking to make them comfortable and convenient internally, and artistic and beautiful in their external design; but they seem so often to forget that the true and healthy decoration and artistic furnishing of the building should be considered and thought out as part and portion of the whole fabric; that they cannot properly be separated, and although, to a certain extent, eclecticism may, and must, prevail in the smaller items of movable furniture, and in the numerous necessary articles which make up the comfort of the various rooms; the general scheme of decoration and fitting up of their houses should form a "part of an harmonious whole, in companionship with other art," and be so designed as in no way to interfere with the healthy treatment of the rooms.

In recent times in the ordinary furniture of our houses we have brought in, it is true, a new order of things, and to a certain extent gone back to the designs of Chippendale and others, and have encouraged the designer and manufacturer to work up to the improved taste of the people; but it seems to me we are yet labouring somewhat in the dark, and do not exercise that forethought and common-sense in the fitting up of our houses, which, combined, would, I believe, add so materially, not only to our comfort, but to the general sanitation of the houses we live in. We are still content to look upon the furnishing of our rooms as more or less the purchasing of various ready-made goods, which can be stored and used for a while, and removed as occasion may require, and in doing this are apt to get furniture and fittings which, like most ready-made clothing are often misfits, and in part only answer the purposes for which they were bought; and are not inclined to consider, with any amount of care, the requirements of the various rooms, to construct our fittings to suit those requirements, and to make them not only useful and ornamental, but part and portion of the rooms we live in; in harmony and keeping with the general design, and carrying out those views which are considered necessary for proper sanitation in all well-ordered buildings.

In fact, we complete our buildings without thought as to their internal fitting up; and when the rooms are painted, papered, and whitewashed, we treat the filling of them with furniture as something quite apart, and, as a consequence, the care and thought bestowed in their design and decoration are often materially marred by the character of the furniture with which we fill them.

More than this: by this want of thought there is often much increased expense in the building, which, by a proper and due regard for its final fitting up and completeness for occupation, might have been avoided. For instance, window recesses—which can be well fitted with box or ottoman seats, answering the double purpose of comfortable resting-places, and store places for papers, clothes, and other household goods—are finished with panelled and moulded wooden backs and skirtings altogether unnecessary; and which have either to be cut away or entirely hidden, if the spaces are eventually fitted up for use.

Recesses in rooms, which naturally suggest themselves as proper places for fitted cupboards, are completed with mouldings and skirtings, which have to be removed, or increase the expense of the fitting, by the labour and time involved in "scribing," as it is called, the fitting to the mouldings, which are not only not wanted, but are absolutely in the way.

Window-shutters and fittings are often so arranged, that when the necessary blinds or curtain poles are fitted to them, the shutters will not open; and when cupboards are provided by the builder, they are often practically useless, or so arranged, that their tops form dust-traps and spaces for lodgment of dirt and filth, which lies for months before it is cleaned away, and of necessity helps to make the rooms stuffy and unhealthy.

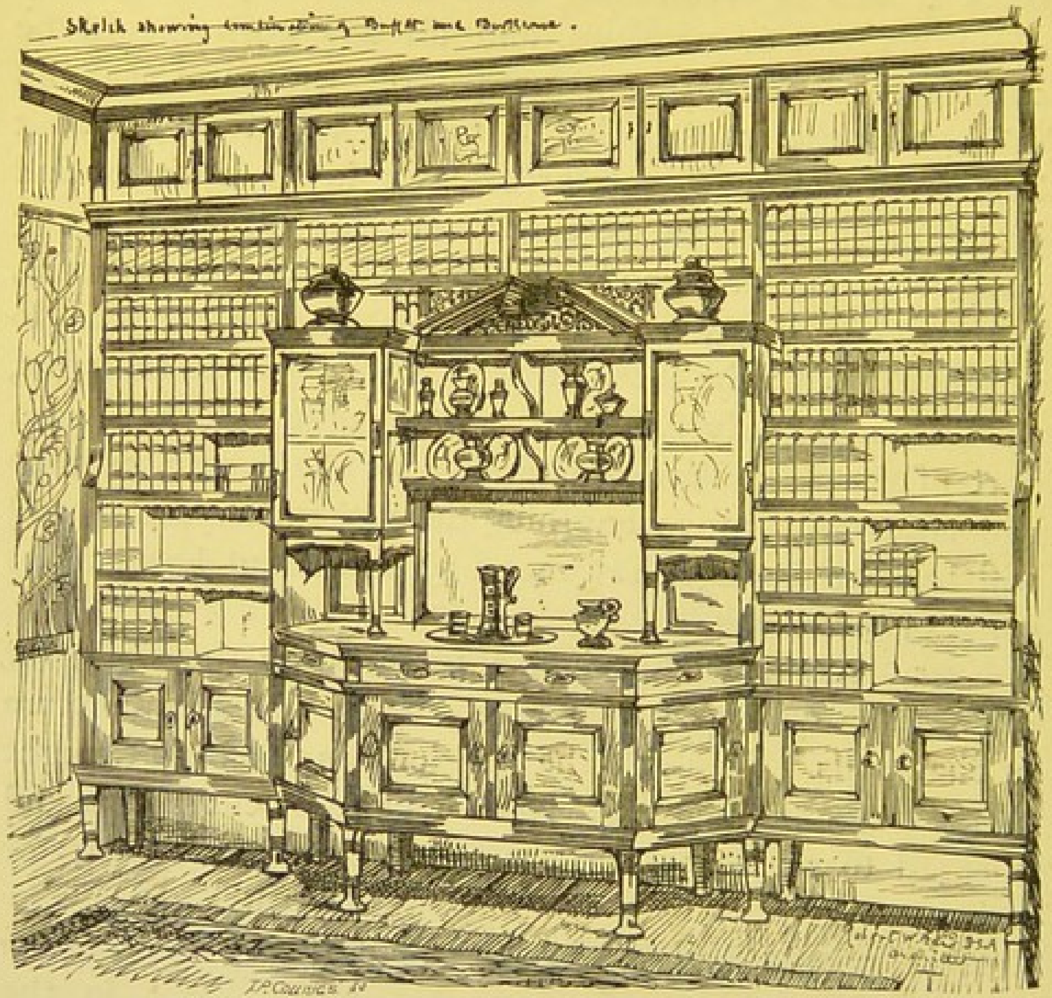
If there is any truth that all fittings and materials which "catch dust, keep dusty, hide dust," and on being "swept or shaken, yield clouds of dust, are bad," then I will ask any of my readers to take an early opportunity of inspecting the tops of their bookcases, or wardrobes, cupboards, or other heavy furniture with which their rooms are filled, and I fancy they will be somewhat startled by what they will see, and believe, that a great deal of these moveable fittings, while filling up the wall space, and difficult to move, even at the time of the periodical autumn and spring cleanings, should be got rid of, if possible, as not only unhealthy, but absolutely uncleanly, for it must be remembered that a certain amount of this dust and dirt gets disturbed by every draught and inrush of air from open windows, and mixes itself with the air we breathe, and falls upon and pollutes everything in the room, carpets, curtains, clothes, and coverings of all kinds.

Most people require nowadays that there shall be some other means of ventilating their rooms, beyond merely opening doors or windows, and all this work should be constructed and arranged as part of the furniture and fittings of the house; that is to say, in all newly built houses, any arrangement for bringing in fresh air, behind grates or through tubes, should not require the cutting away and making good, and therefore double expense, usual wherever any system of ventilation is attempted to be carried out; the tubes, instead of being after-thoughts, should be properly arranged and thought out, and form part of the decorative construction of the rooms, or they will necessarily prove anything but artistic additions, and will tend to damage the general pleasant and harmonious effect of the rooms.

Every one nowadays hangs pictures on the walls, or divides the wall-spaces by mouldings, which form picture or chair rails. As a rule the builder has taken no thought of these requirements, the walls have to be cut about and plugged to secure the proper fixing of the mouldings or rods.

Most people have a certain number of books, which they want to arrange in some convenient place in the library of the house; either moveable bookcases have to be provided for these, or, if recesses be fitted up, there is a good deal of extra expense and damage caused by cutting away the walls, cornice, and skirting; and finishings, which have all cost money, have to be cut away or covered up, so that practically double expense is incurred.

I hold that all these, to my mind essential features in every good house, should be thought out and arranged for in the general planning of the rooms; that in fact, as

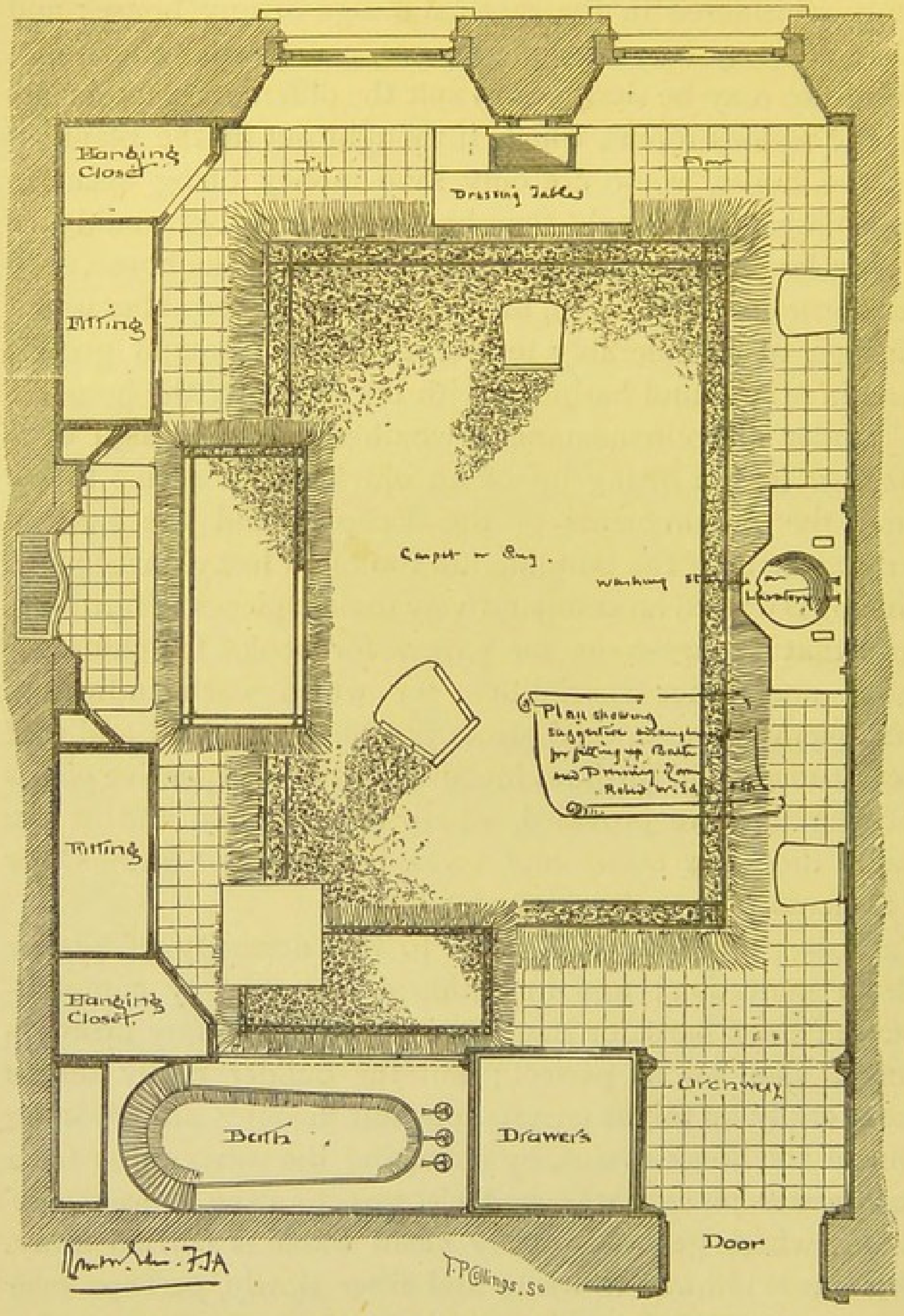

Sketch showing combination of Buffet and Bookcase.

SKETCH SHOWING COMBINATION OF BUFFET, CABINET AND BOOKCASE.

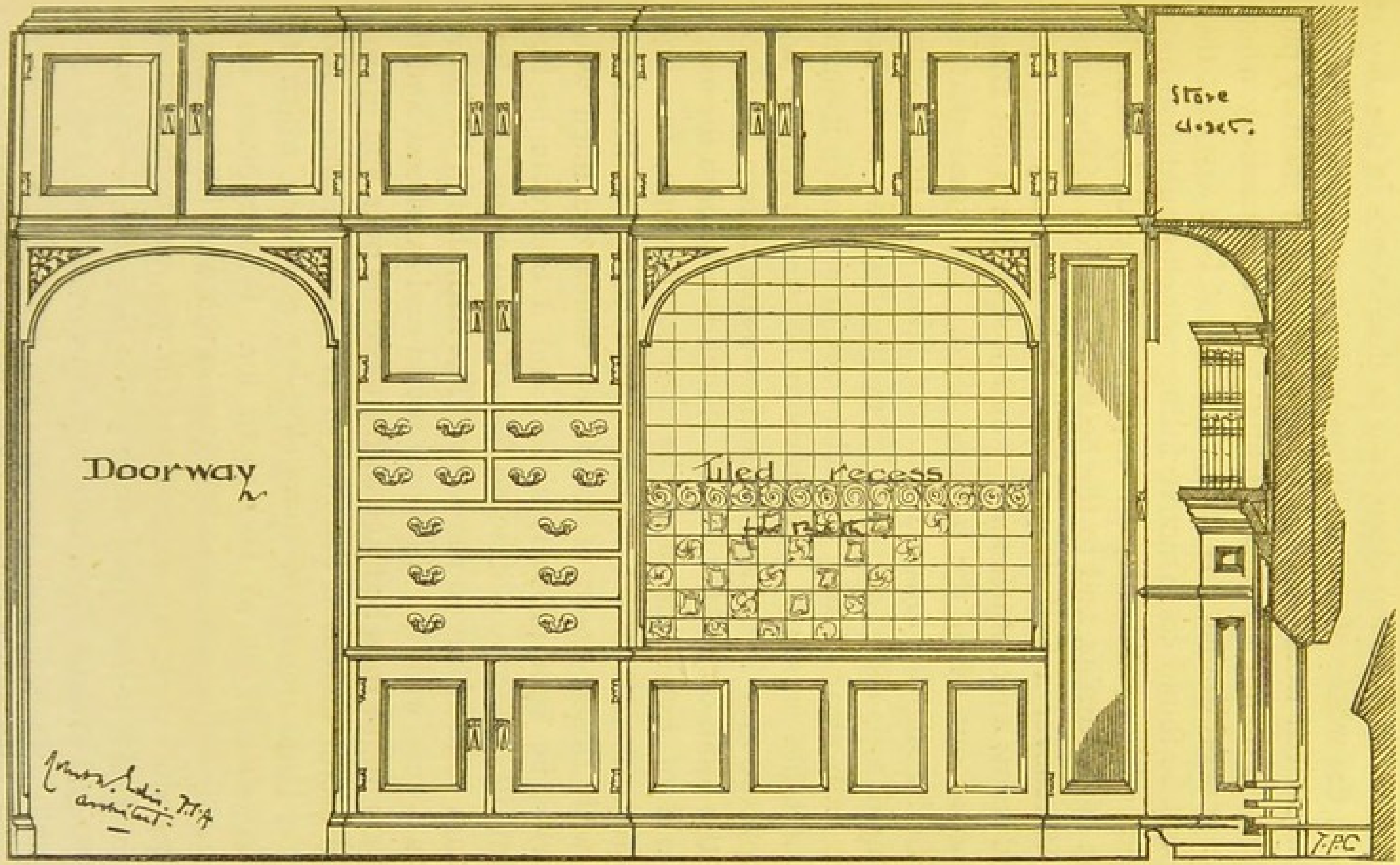
far as possible, the question of planning furniture and fixing up recesses, window and other openings, should be duly considered in the original design of any house; and that in many rooms of the houses, constructed and useful furniture may be designed to suit the different requirements of the various rooms, which, if thought out in the planning of the house, would not only save money being spent in finishings, which would then be unnecessary, but would provide a large amount of the heavy furniture of the house, such as wardrobes, bookcases, buffets, box-seats, and other useful fittings, at considerably less cost than the bought goods; and in accord and harmony with the design of the house.

Under any circumstances, whether in the design of a new or in the fitting up of an old house, it seems to me that the requirements of the occupier, and the healthy arrangement of the building are too often lost sight of; that money is wasted on comparatively useless pieces of furniture, and that storage-room for papers, for books, for china, for guns and other specialities, for which each individual occupier requires special places, is seldom provided, and that ready-made and ofttimes inconvenient and expensive pieces of furniture are provided, where more simple and at the same time less costly and more convenient "fittings" or "fitments" are really wanted.

Most people are still alive to the necessity of proper drain sanitation; and in taking a house, every common-sense person bargains that the drains and sanitary arrangements shall all be perfect; but the builder rarely thinks how easily he might ensure constant flushing and cleaning out of the house-drains, by collecting the waste water from rain-water pipes, baths, and cisterns, or even housemaids' sinks, where generally fairly clean water is carried away. All this is allowed to waste and filter slowly, perhaps over open traps, into the various drain outlets. At the cost of a few pounds, one or more of the many flushing-tanks, now invented, might be placed in the front or back area, or both, into which the waste water from baths, housemaids' sinks, cisterns, and rain-water pipes, might easily be collected;


Hanging Closet
Tile
Dressing Table
Tile
Fitting
Carpet or Rug.
Washing Stand or Lavatory
Plan showing suggestive arrangement for fitting up Bath and Dressing Room. Robert W. Edis FSA
Fitting
Hanging Closet.
Bath
Drawers
Archway
Door
Robt W. Edis. FSA
T.P. Collings, Sc.

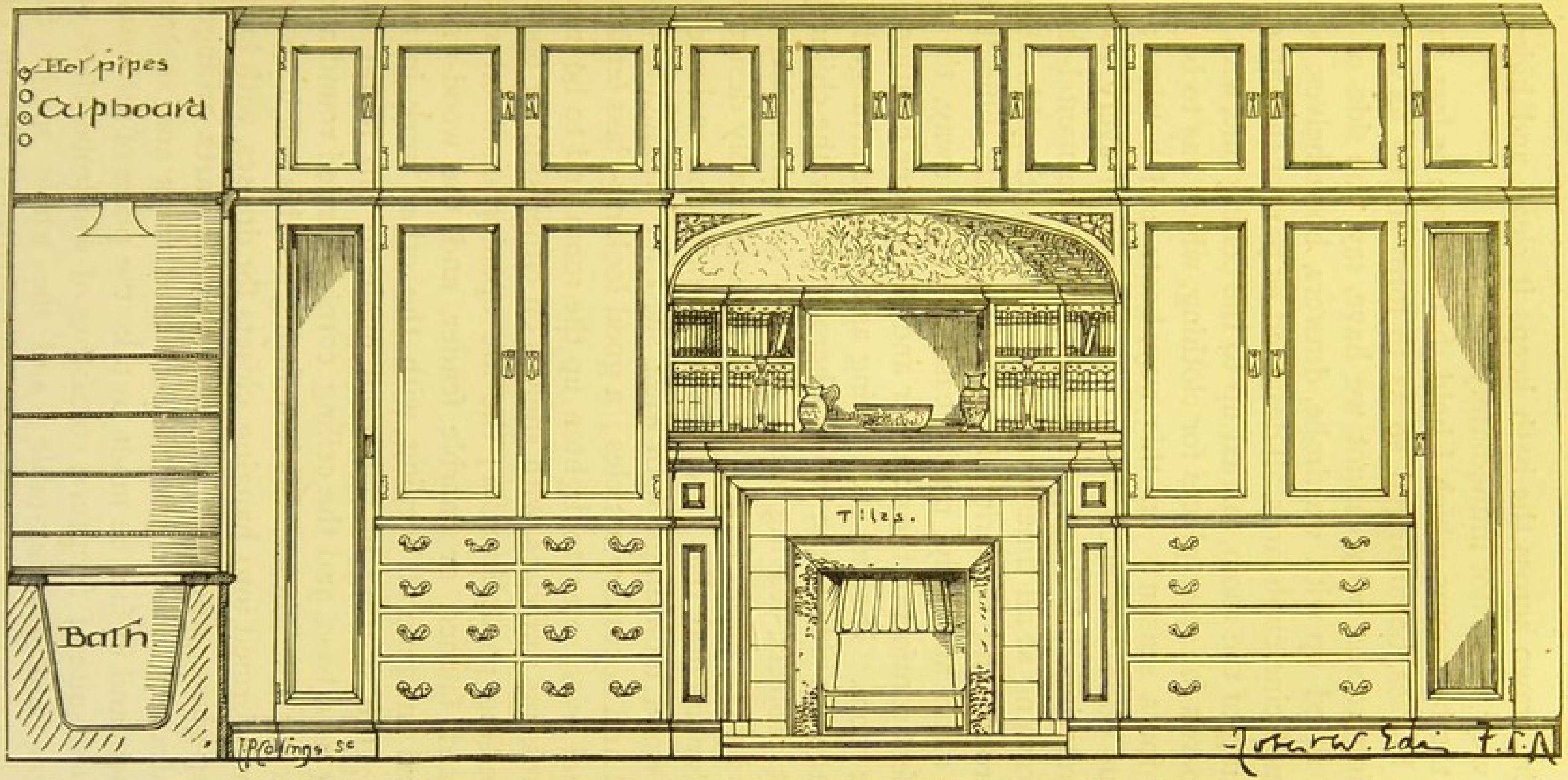
PLAN SHOWING FITTING UP OF DRESSING-ROOM WITH BATH AND FITTINGS.


Store closet.
Doorway
Tiled recess
for the Bath
Robt. W. Edis. F.S.A. architect.
T.P.C.

SKETCH ELEVATION SHOWING END OF DRESSING-ROOM WITH BATH-RECESS, ETC.

and these tanks, being automatic, would, as they were filled, continually let loose a great body of water back and front, so as to sweep clean, two or three times in the day at least, the whole of the main house-drain, and thus the water now wasted would be made useful for sound sanitary purposes. I do not say these flushing-tanks are necessary where the general drainage is really sound, but I do say that they would be found constructive fittings which would materially tend, without difficulty or expense, to the daily scouring out of the drains, and to the better sanitation of the house.

Whenever a bath is provided, it is generally left open, and forms a receptacle for dirt and dust, which is not always cleaned out when the bath is filled. I suggest that the bath be slightly lowered into the floor, and fitted with a hinged top, about seat-high from the floor, so as to keep the bath clear of dirt, and when not in use make it answer as a table or seat. A bath-room is often fitted up with cupboards for linen, and if the hot-water cistern be placed in the room on the floor level, or sufficiently high for use, or a coil of hot-water pipes be carried through, the linen cupboard with lattice shelves, might easily be fitted over it, with closed doors of course, by which the linen would always be kept properly aired; and if the room be lined with tiles, there would be no fear of damp or moisture from steam condensing on the walls. The bath should be formed in a recess, with tile lining all round and overhead, and the recess might then be fitted with cupboards over, and drawers and useful shelves at one end, so as to provide storage-room for a large amount of spare clothing and linen, which it is often so difficult to find room for. I have given three drawings of a bath-room fitted up in this way, illustrating to a certain extent my suggestions; in this, the bath is placed at one end of the room, while at the side and overhead are arranged various cupboards and drawers, utilizing the space usually wasted, and placing the bath in a glazed-tile recess, with the hot-water pipes passing through the cupboards so as to keep them fairly well aired for the storage of household linen, or clothes not immediately wanted; a


Hot pipes
Cupboard
Bath
Tiles.
J.P. Collings sc
Robert W. Edis F.S.A

SKETCH ELEVATION SHOWING FITTING UP OF FIREPLACE SIDE OF DRESSING-ROOM.

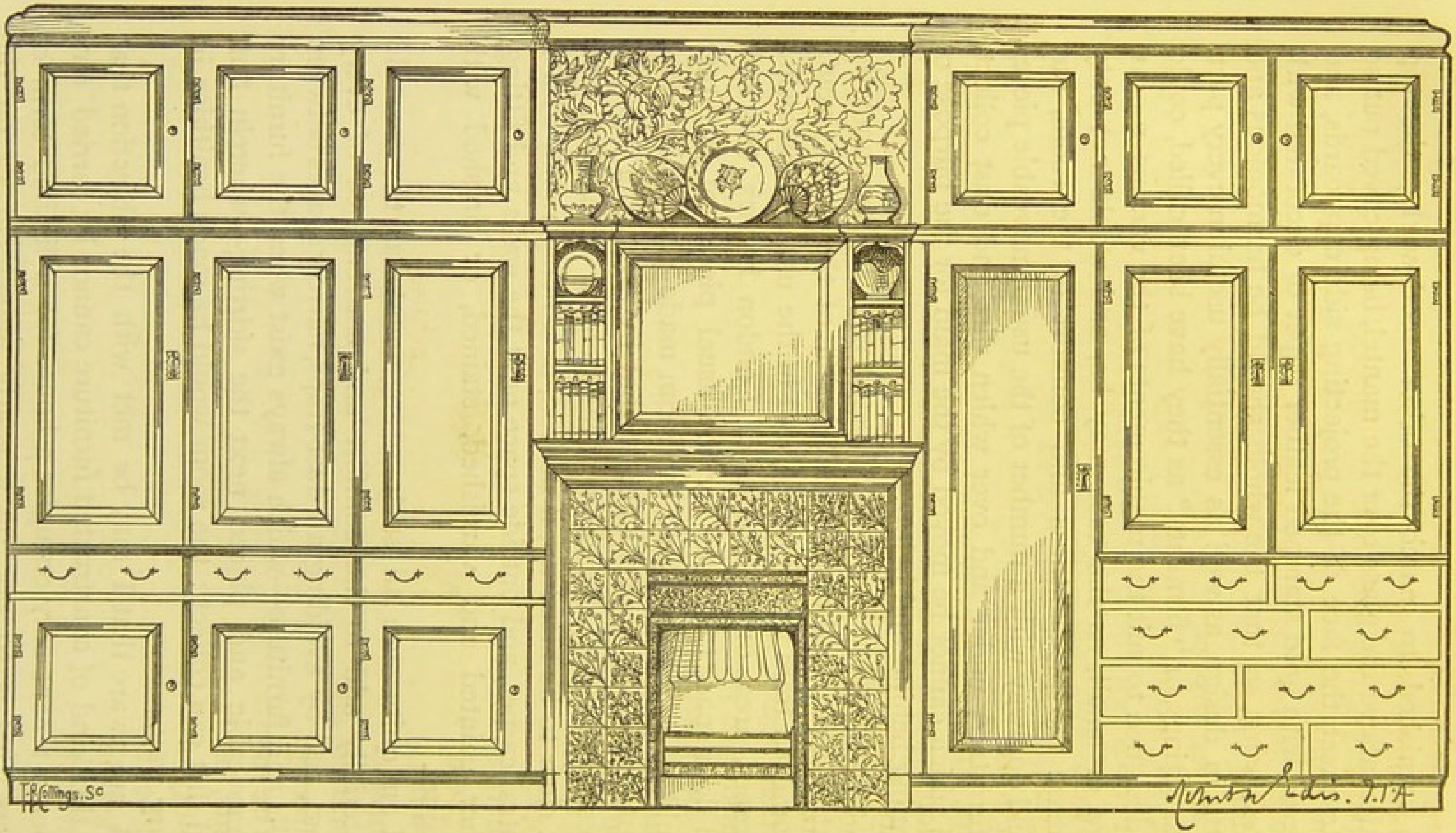
curtain drawn across the bath keeps it clean, and hides it from view when not immediately required.

In the bedrooms, which I hold should more or less, in all town houses, be arranged so as to form sitting as well as sleeping rooms, why cannot we have, say, one side of the room fitted up with wardrobe, drawers, bookshelves, boot, and medicine cupboards, all designed as part of the internal finishing of the room, carried up to the ceiling line, with top cupboards for store places for clothing, which has to be put away for a season? In this way, boots and bottles, and various odds and ends which accumulate in every room, encumbering and littering the floor-space or the mantel-shelf, and forming at all times unhealthy and objectionable items in a room, and rendering it at the same time difficult to keep clean and tidy, might easily be put away, to the manifest comfort of the occupier and the greater healthiness of the room. If some such fitting as this were arranged on the fireplace side of the room, where generally the chimney breast projects, leaving deep recesses on either side, the mantel-piece might form a central feature, simply designed with ornamental tiles next the iron grate, and enclosed in plain wood mouldings, with wide shelf for ornaments and useful and necessary articles; a good looking-glass let into a panel over, so as to lighten up the room and to be used for dressing purposes, with shelves on either side for books or dressing paraphernalia; the fire opening enclosed with a glazed faïence, or marble fender, and the wood-work finished in general keeping with the other work in the room; the skirting of the room made to run round the fitting as a base, and the ceiling cornice carried round and enframing the whole. Such a fitting as this might have the ends formed into hanging closets for dresses, with long looking-glass panels let in, and in other parts arranged with drawers, boot cupboards, enclosed trays and shelves for linen, and in fact be made to take the place of the usual so-called suite of furniture, consisting of wardrobe, chest of drawers, and dressing-table; and the whole might be carried out in plain deal stained and varnished, or painted and varnished, to match the other wood-work; the top portion above the glass over the mantel, being coved out so as to meet the face of the projecting side cupboards, and covered with gold stamped leather paper or decorated with stencil work, so that the whole should be harmonious and pretty in design, as well as essentially useful in every part. Such fittings, or "fitments" as they have been called, could be designed to suit the requirements of the various rooms, large or small, as the case may be, and would not only increase the pleasantness and comfort of the room, but would do away with a number of the usual moveable pieces of furniture, under and over which dirt and dust collect, and which cannot be moved by the maid for the purpose of cleaning behind and below.

Expense would be saved, to begin with, in the room; the skirting-board and cornice on this side of the room, would be omitted from the first cost, and in the usually somewhat cramped areas of the rooms of London houses, the wall and floor space taken up by the usual pieces of furniture would all be lessened, and the room made practically more comfortable and convenient; so that by arranging the bed recess at one end, the whole of the general area would be left clear to be fitted up, if desired, as a living room, with a central carpet, and outside space next the walls and fitting, either painted and varnished, stained, or finished with parquet.

I am quite sure all such arrangements as these would materially add to the comfort and convenience of every room, and by avoiding all dust-traps, narrow spaces between walls and furniture—which always exist when the furniture is moveable and placed next the skirting—wherein fluff and dirt can collect; the room would be made healthier in every way.

I am aware that I may be met with the objection that all this kind of constructed furniture cannot be carried out, when a tenant only occupies a house fot a limited term of years, that is to say, on a yearly agreement, or on the ordinary leasehold tenure of seven, fourteen, or twenty-one


T.R.Collings. Sc
Robert Edis. F.S.A

SKETCH ELEVATION SHOWING SUGGESTED FITTING UP OF ONE SIDE OF AN ORDINARY BEDROOM.

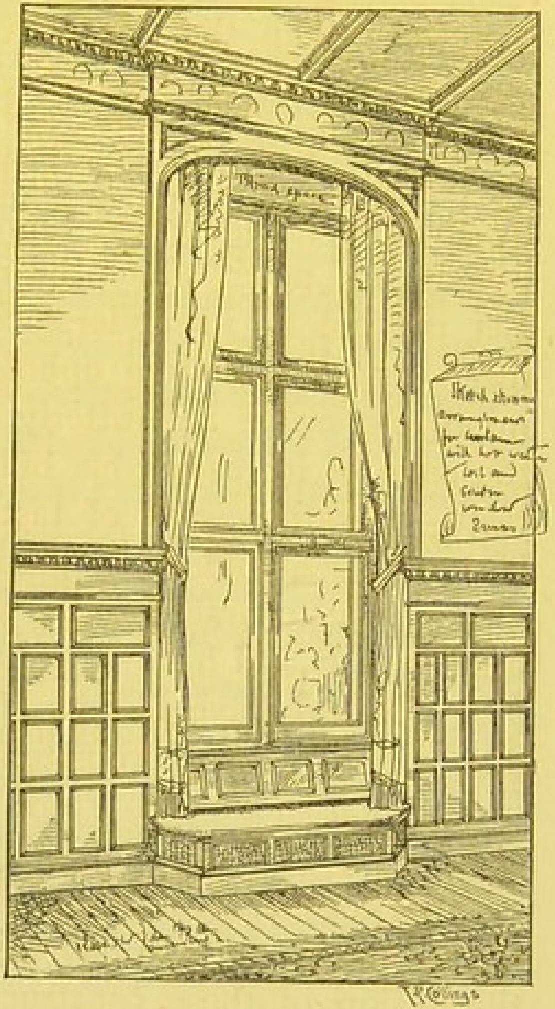
years, inasmuch as the fittings arranged as I have suggested, if absolutely fixed to the walls, become more or less the property of the landlord at the end of the term; but even supposing they are not made to unscrew and take to pieces, so as to leave them as tenant's and not landlord's fixtures, and that, when taken down, they would not fit in any other house: I believe that, as a general rule, an incoming tenant would be glad to take them over at a fair valuation, after allowing for depreciation for wear and tear; and when it is remembered that, to a great extent, a good deal of the ordinary furniture of a house practically requires renewal about every twenty years, either from wear and tear, or being unsuitable from various causes, it follows that at the end of a term of 21 years' lease, the special fittings will, in a measure, have almost paid for themselves, and we should have to incur no more cost in providing some such similar arrangement in another house, as we should have to do in buying new furniture, in place of much of the old, which, as a rule, would not be found suitable either to the new house, or the enlarged views and increased requirements which we should probably have at the end of such a term.

I may be wrong, but I believe a house fitted up as I suggest, would, to most common-sense people, command a higher rental, and that thus a fair and ample percentage on the preliminary outlay might be secured; but even if this were not so, surely the increased comfort and health of the occupants of the various rooms must be taken into consideration, and what we might lose directly, we should gain indirectly.

The question of constructional and decorative improvements, as between landlords and tenants, will, in all probability, undergo a material change in the next ten years, and be made the subject, as they undoubtedly should be, of legislative consideration; for the present iniquitous system by which the landlord reaps practically all the advantages of alterations and improvements, which are absolutely necessary to make the usual badly built houses fit for decent, comfortable, and healthy occupation, cannot in the nature of things, be much longer maintained; and as, year by year, legislation is seeking to improve the position of the tenant in all questions of holding of land and farm buildings, I cannot but believe the present unfair arrangement of leasehold tenure and ground rents in house property, will, ere long, be fairly met; by which I am morally certain a much better character of building will be ensured in our cities and towns.

In most houses it is common to have the store places for clothes and other household goods, practically self-contained in every room, and therefore we put therein furniture sufficient for our requirements; but we all know how soon our drawers and wardrobes get overcrowded, and the nuisance and annoyance it often is to have to take out coat after coat, or dress after dress, until we reach the particular one we want, which may be stowed away at the bottom of the drawers or chest, and it surely must appeal to ordinary common sense, to utilize in every way, with constructional fittings as far as possible, all spaces which, as a rule, are practically useless. If the cupboards are taken up to the ceiling line, that is to say an extra tier added to the ordinary wardrobe fitting, increased store-room would be provided for clothing not immediately required. There would be less crowding up of the existing cupboards and drawers, and the ills of the flat exposed tops of the ordinary fittings, to which I have before referred, would be done away with. Why not, in the window recesses of every bedroom, provide fixed ottoman boxes which can be used as seats, as well as store places, and if covered with stuffed tops, may thus, not only be made useful, but comfortable; while in the sitting-rooms they might be used for store places for papers and magazines until bound up, and thus help to do away with the littering of our rooms, or the storing away of all such things in inaccessible places, where they are seldom dusted, and only help to breed dirt and disease.

While we may delight to collect artistic and valuable pieces of furniture, as we may collect pictures, engravings, or china, we do not want to make our rooms into curiosity-shops or museums, and must have a certain amount of absolutely useful furniture in every room, and if we watch the progress of the art of furniture in all ages, we find that while it gradually became more luxurious and elaborate in its finishing, the artists who designed them always bore in mind, to a great extent, the necessity for the various pieces being made useful, and it was not until the Rococo period of the last century, that mere show, caprice, and elaboration, formed the chief elements in furniture design. The old coffers, cabinets, double-bodied presses, or armoires, credences, and buffets, of the sixteenth century, while elaborate and luxurious, were generally adapted for the requirements of the people; and to-day, when the requirements and the general comfort of our surroundings, as well as the healthiness and wellbeing of the people, are daily becoming more thought of, we may fairly insist that the fitting up, and arrangement of the interiors of our houses, should be just as much considered as the external elevation, or the mere decoration of our walls.



If instead of the usual heavy and ugly valances, which so many people still insist upon placing over their windows, as a top-finish to the curtains, we were to provide framed recesses constructed with the architraves, or mouldings, which run round the window-openings, with slightly arched heads, leaving room for a slight iron rod to be fixed behind and out of sight, with space for the proper and easy running of the curtain, we should, to my mind, have not only a much more artistic, but certainly a much more healthy and less expensive arrangement ; and these arched heads would form part of the constructive finishing, at no more cost than the framed and panelled window linings and architraves, and if carried up to the ceiling, with the cornice returned round, would leave no spaces for the accumulation of dirt and dust, such as are now provided by the projecting boxed linings and the heavy valances, fringes, and poles, which the modern upholsterer provides. Let me not be misunderstood in this remark ; I do not mean that the modern upholsterer provides these, to my mind, expensive and utterly unhealthy arrangements for the sake of increasing his bill, he does it often to suit the taste—or rather want of taste—or want of knowledge of his employer, and in ignorance of the better effect and more artistic character of the simpler and more constructive fittings such as I have suggested, and practically from the fact, which I have always so strenuously sought to condemn, that the furniture is treated entirely as a separate art in the household, and is not in any way considered, as it should be, as forming part of the general design of the internal constructive fittings of every house.

It is impossible to lay down any particular rules for the design of these constructive fittings, nor would I if I could ; they must be made to suit the various rooms and requirements of the individual owner ; but I do say that the use of properly designed and arranged constructive furniture should enter much more largely, than it does at present, into every home ; and that if considered in the planning, and carried out in the finishing of the house, more comfort and better arrangement of the rooms might be combined with considerable saving of cost, and infinitely better artistic and healthy character of the general fittings of the building.

In the dressing-rooms, where, as a rule, in town houses the space is very limited, every one knows how difficult it is to provide room for all the articles of furniture required. All such constructional fittings, such as I have named, would add materially to the healthiness and convenience of the rooms and the comfort of the occupants. The bedrooms and dressing-rooms should be clear of everything, as far as practicable, that can collect or hold dust in any forms, should be bright and cheerful, pleasantly furnished, not with the everlasting heavy mahogany wardrobes, and dingy-looking chests of drawers; but with light and cheerful furniture, of good and simple design, in which everything should be carefully arranged and studied for use, not show. We do not want heavy and unnecessary hangings and furniture, which hold dust, keep dust and are necessarily unhealthy; for if we are to secure healthy and refreshing rest and sleep, it is of the highest importance that nothing shall take away from, or taint the pure air, which is necessary during the hours of sleep; so that our waking may not find us feverish and nauseated by the continual inhaling of the impure air, which all such dirt and dust-traps tend to create.

"The wall surfaces of our bedrooms should be hung with some small and simple decorative paper of one general tone, but with no particularly emphasized design, so that we are annoyed at night with flights of birds, or symmetrical patterns of conventional primroses, daisies, or fruits, which might in any way suggest a countless and never-ending procession along the walls. Any pattern or design which shows prominently any set pattern, or spots which suggest a sum of multiplication, or which, in the half-light of night or early morning, might be likely to fix themselves upon the tired brain, suggesting all kinds of weird forms, are especially to be avoided.

"The design should be of such a description that, saving as regards colour, it should offer no specially marked pattern. I have seen various designs for papers of high artistic character, but in which flights of birds, or rows of conventional flowers stood out in bold relief, suggesting ideas of counting, or dreaming thoughts or restlessness, which, to an over-tired or restless brain, soon bring utter wakefulness."

The general wall surfaces should be varnished if possible, so that they may be easily cleaned down and be made practically non-absorbent.

The general wood-work of the doors, windows, and skirtings should be painted in some plain colour to harmonize or contrast with the wall decoration, and the whole varnished ; wood-work finished in this way can be easily washed or cleaned, and the extra expense of varnishing will be saved in a few years. The bed should be of brass or iron, the furniture of light wood, varnished or polished ; and, now that good painted tiles can be obtained at small expense, they may be used in washing stands with good effect, or the wall above may be lined entirely with them to a height of 2 or 3 feet.

There are now so many really good designs of wall-hangings of subdued and harmonious colouring, that there should be no difficulty in selecting such a one. It is well to remember that the greatest artistic skill of colouring alone can so graduate all the various colours as to confuse the eye without attracting it to any given portion of the design, and that, therefore, it is far safer to trust to some really good distemper colour; and this should, and may well be, of such an absolutely undefined shade that you hardly know what to call it. A little thought, a little study, and a little time will be well spent in the careful furnishing and decoration of the sleeping rooms of our houses, so that they may be healthy, cheerful, and comfortable.

I need scarcely say that the laws of health require that there shall be ample ventilation in all the sleeping rooms of the house, or they will get stuffy and absolutely unhealthy at night when shut up, and there is no opening and shutting of doors and windows for ingress of fresh air, and no fires for egress of foul air. Fresh air must be brought in either by the ordinary gratings and tubes through the outer wall, or from the staircase well, in which there is generally a fair supply of fresh air, although not always of the purest kind, by means of ventilators over the doors. All this kind of practical decoration is as necessary for bodily health, as art decoration is for mental enjoyment and pleasure; and if the one be neglected, the other may almost as well be left undone; for it is hardly necessary to point out that at "every inspiration of the lungs, a certain quantity of oxygen is withdrawn from the air of the room, and at every expiration a certain quantity of carbonic acid is given off; and unless the carbonic acid can be got rid of, and fresh oxygen be supplied to take the place of that which has been lost," the atmosphere of the various rooms soon becomes foul and oppressive.

As regards the general floor surfaces, let them be entirely painted, or stained and varnished, so as to present non-absorbent and easily cleaned surfaces, or better still finished with parquet flooring, which is almost entirely non-absorbing, and which can be cleaned by a damp cloth every day; with rugs or simple homespun carpets laid down beside the bed, and elsewhere, where required, so as to be easily taken up and shaken every day without trouble; and if you do away with all resting-places for dirt and dust on the tops of wardrobes and hanging closets, and behind and under chests of drawers and other heavy furniture, there will naturally be much less labour required in cleaning and purifying the rooms.

It is hardly necessary to insist that any system of furnishing or covering of wall or floor surfaces which helps to decrease the stuffiness, and to add to the healthiness of the bedrooms, by removing, as far as practicable, all spaces that hold or harbour dirt and dust, and interfere with the thorough circulation of air during the long hours of night when the rooms are necessarily shut up, will be in every sense desirable. Heavy curtains should be avoided, indeed I do not see why curtains are needed at all in bedrooms, if the window-blinds be of some dark toned stuff sufficient to hide light, and to keep out the glare of the morning sun.

The nurseries of the house, the rooms in which our little ones spend so much of the early portion of their lives, should naturally be made healthy and beautiful, fitted with cupboards and cheerful light furniture; with no holes and corners in which broken toys and damaged picture-books may be stowed away; the wall space utilized with planned furniture, divided as far as possible for each child, with the floor space left as open as possible for exercise and play. Nothing should interfere in these rooms with ample light and sunshine, for as plants turn toward the sun and light, so children grow up more healthy, where care is taken to avoid darkness and dinginess; and on the careful and proper fitting of their rooms depend their bodily, as well as mental health; want of light and sunshine means everywhere, "stunted bodies, imperfectly formed blood, feeble limbs, dull senses, and torpid minds," as Miss Nightingale says in her 'Notes on Nursing,' "where there is sun there is thought; all physiology goes to confirm this; where is the shady side of deep valleys; there is cretinism. Where are cellars and the unsunned sides of narrow streets, there is the degeneracy and weakness of the human race, mind and body equally degenerating. Put the pale withering plant, and human being into the sun, and, if not too far gone, each will recover health and spirit."

In all the upper rooms of a house, which may be used as nurseries, I would, where practicable, construct semi-octagonal projecting bays, so as to provide for the greatest possible light and sunshine; and if this cannot be arranged, the windows should be as widely splayed inside as possible, and no light or sunshine shut out by heavy curtains or venetian blinds; and here, too, as in the best rooms of the house, should be thick plate, instead of the miserably thin glass, which is considered sufficient in the upper portions of so many houses; the thick glass gives truer light, is less penetrated by sound, and helps to retain the warmth of the room after the fires have gone out, and the house is left to cool in the long night hours. For ventilation, some such pleasant arrangement as that originally designed by Mrs. Priestly, the wife of the eminent physician, and which may be made part of the constructive fitting of the windows, may be carried out. This consists of a double glass lining, or practically a small glass case fitted into the window, a little way away from the external light surface, with folding glass doors to open in front, but with the top left open, so that the lower sash may be raised, and, without draught, admit fresh air into the inner case, which escapes at the top, and finds its way upwards into the room, and helps to keep the room pure and sweet. The case may be filled with flowers, and the top covered in with thin gauze or silk, so as to prevent blacks and other impurities being drawn into the room, and the air passing over the plants or ferns is filtered and purified, the plants absorbing, to a large extent all the "ammoniacal and carboniferous impurities," with which the air of large towns is materially laden, while the charm and colour of the delicate fern foliage, and growing flowers, add to the pleasant aspect of the room.

All these, you may say, are small matters; but they make up half the evils and half the troubles of life, and are certainly well worth considering in rooms in which our children live and sleep.

Apropos of nurseries, as I wrote in an article in 'Our Homes,' "it is possible that there may be some sort of sentiment existing which makes mothers desire to keep for all time, the long disused toys belonging to their children in early life. I have seen boxes and cupboards half filled with broken toys and other useless lumber, which only serve as resting-places for all kinds of impurities, seldom disturbed, and rarely cleaned out; while in our hospitals, and amongst our poorer neighbours, there are hundreds of children who would be delighted with these no longer required toys and belongings of our own childhood. Clear out all such lumber, and give all that is fit for anything—old picture-books, old toys, old clothing—to those who will heartily appreciate them, and, while conferring a pleasure on these little ones of our poorer neighbours, who cannot possibly obtain, in any other way, such things as toys and picture-books, we shall be clearing away things which are now only lying useless in some out-of-the-way corner or cupboard, and adding to the comfort and cleanliness of our own house. How many thousands of poor children are there who would be benefited and amused, and whose lives might be made more cheerful and more happy by the contents of many a box or cupboard of toys and books which are no longer required. Every housewife knows how old books, old papers, old clothes, old linen, accumulate in the course of a few months. Instead of these being periodically cleaned out and given away, they are often carefully stowed away, in the most out-of-the-way places, practically as useless, and help to make the rooms and house generally stuffy and unhealthy, when they might be the means of giving health and pleasure to others who have no means of purchasing them for themselves."

We are so apt to think that the commonest of furniture so long as it is fairly strong, is good enough for our nurseries; surely this is a cruel and unwise thought, for our little ones should above all, be brought up amongst beautiful things, and graceful influences. Let the fittings and surroundings, and the decoration of their rooms all help to inform and impress upon their minds something of grace and beauty of form and colour, and assist in the early teaching of their sense of sight. Surround them with pretty objects, teach them method and tidiness, by having everything about them showing tidiness and method; teach them to love nature, to appreciate good form and colour; let them see how Nature "restricts her true ornaments, the flowers, to the most salient and culminating points of plants, and sprinkles them sparingly, contrasted with the foliage; that art itself is nature," and that, as Shakespeare tells us,

> "Nature is made better by no mean
> But nature makes that mean: so o'er that art
> Which you say adds to nature, is an art
> That nature makes."

The walls of the nurseries should be hung with some bright and cheerful pattern paper, varnished for health's sake, while the upper portion should be distempered; the upper space or frieze should be divided from the general wall surface by a small deal painted picture rail, but the ceilings and frieze should be cleaned off and re-distempered every autumn, as nothing tends so much to sweeten the rooms as this annual cleaning off and re-doing of the ceilings, which naturally are more impregnated with the impurities of the shut-up rooms than any other portion of them. Paint or varnished papers are always more healthy than distemper, as they can be readily washed, and do not absorb and hold dirt and other impurities.

The walls of the night nurseries should be hung with a soft, general toned paper, varnished, so as to be sponged every week, or distempered all over, so as to be re-done at small cost at frequent intervals, for it is essential in the ordinary low-pitched upper rooms of town houses, generally devoted to nurseries, to wash out as often as possible, the peculiar stuffy bedroom atmosphere, which must be absorbed in the walls and ceilings of all low rooms. The tone of colouring or pattern on the walls should above all not be spotty or glaring, with strongly defined forms presenting nightmare effects to drive away sleep, or disturb our little ones in the hours of feverish unrest or sickness. But in the rooms they live in there is no reason why the "writing on the walls" should not be the earliest teaching of all that is beautiful in nature, art, or science, and by good illustrations of fairy lore and natural forms incline the thoughts of our children to all that is graceful and beautiful in nature or imaginative faculties.

No pains should be spared to render the nurseries of the house as cheerful and pretty as possible, or to secure ample light and thorough ventilation. "To surround our little ones with decoration and every-day objects, in which there shall be grace and beauty of design and colour, instead of the commonplace and vulgar tawdriness, which in so many houses is thought good enough for the nurseries, will imbue them with a love and appreciative feeling for things of beauty, and harmony of form and colour; but if we wish to have healthy children, we must have healthy homes, and, in studying how best to decorate the walls, do not let us forget that it is first of all imperative that there shall be no overcrowding of the generally low rooms, and that ample light and pure air are essential to their bodily and mental health and wellbeing."

CHAPTER IV.

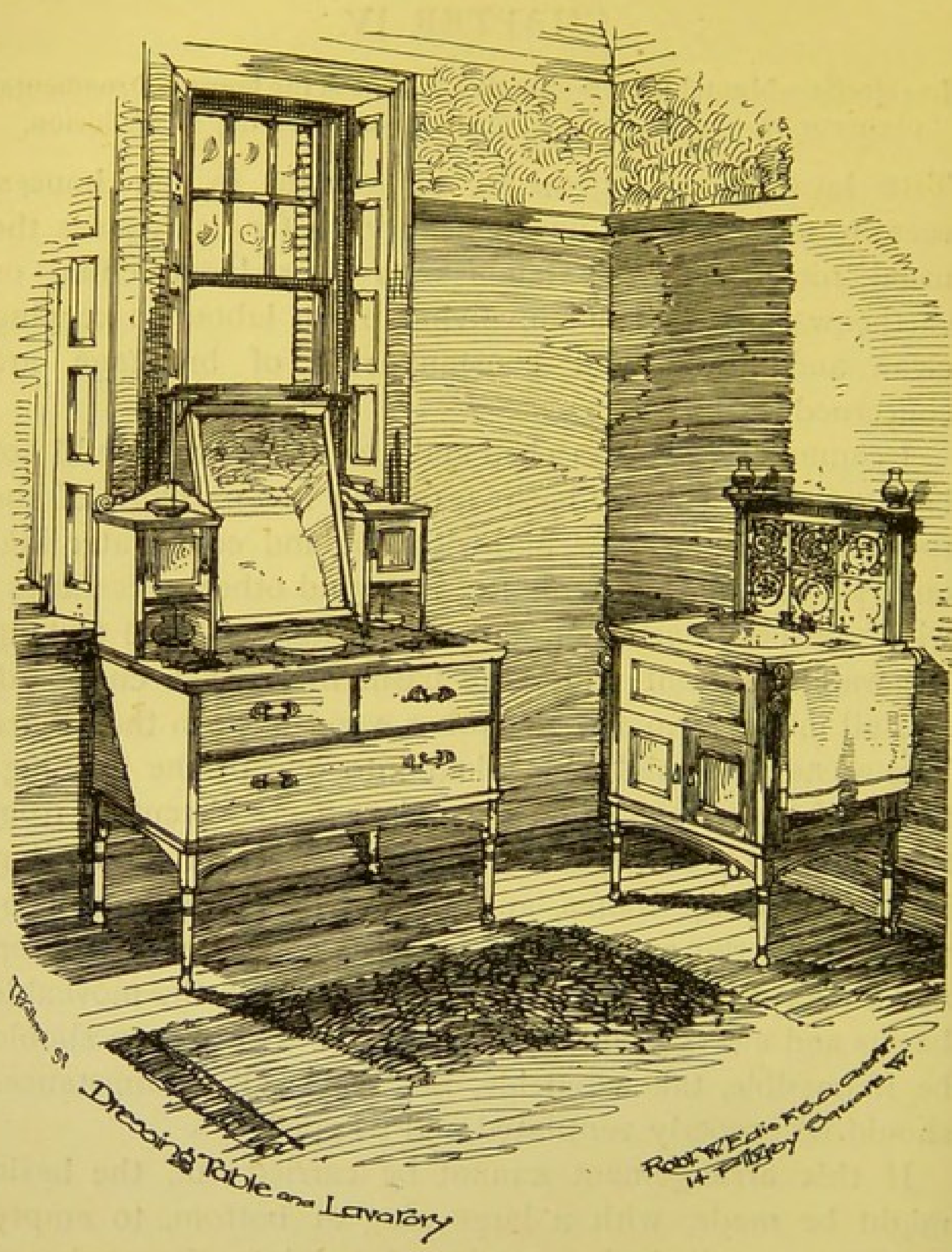
Lavatories—Mantel-pieces—Smaller fittings of the house—Ornamental plaster-work—leather papers, &c., for wall covering—Conclusion.

THE lavatory arrangements, in general in our houses, seem to me generally unsatisfactory, so far as regards the usual moveable wash-stands with their loose china or earthenware fittings, all involving much labour in keeping clean and filling, and constant risk of breakage, are concerned.

I cannot see why every bed and dressing-room should not be fitted with a tip-up basin arranged in one angle of the room, next the window, and with hot and cold water laid on, with marble top, sunk for soap and other necessaries; with polished marble or glazed tile sides, about 2 feet up the wall; the front under the basin fitted as a cupboard, and all made to match the other wood-work in the rooms. The waste-pipe might be taken into one of the flushing-tanks I have named, or be otherwise effectually cut off from the sewer, so that there need be no fear of foul air finding its way into the rooms, and thus the comfort and convenience of the room would be still further provided for, and the expense and extra labour involved in the moveable basins and ewers done away with; the waste-pipes should be, if possible, taken outside, but under all circumstances should be properly ventilated and trapped.

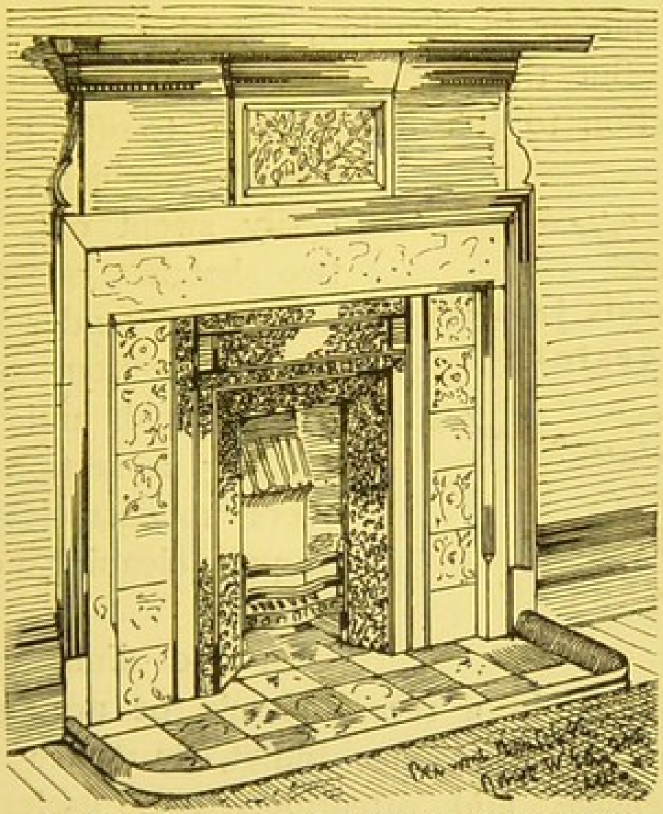
If this arrangement cannot be carried out, the basin might be made, with a large plug at bottom, to empty into an enamelled zinc receiver fitted into the cupboard under, this could be emptied by means of a tap at bottom or be made to pull out and to be emptied in the usual manner.

In the reception-rooms of a house, much expense might be saved by making the mantel-pieces much more important features than they are at present; if instead of the usual cheap


Dressing Table and Lavatory
Robt. W. Edis F.S.A. Archt.
14 Fitzroy Square. W.

SKETCH SHOWING COMBINATION DRESSING-TABLE AND DRAWERS, &C.

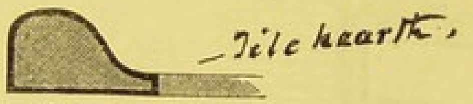
and trashy marble mantel, with its heavy and vulgar trusses supporting nothing, we were to have simply designed wood mantels, filled in with marble slips or painted tiles next the fire grates, with recessed looking-glass over, and cupboards and shelves at the sides made for holding ornaments or guns, or books, cigars, or whatever else might be required in the particular room for which it was designed; how much more artistic would be the effect of the room, while at the same time a useful piece of furniture would be provided.



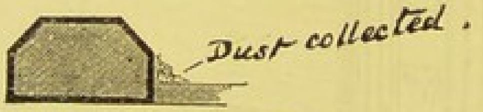
SKETCH DESIGN FOR CHEAP MANTEL-PIECE AND STOVE.

I do not mean that we should perforce buy one of the present ready-made fashionable, so-called over-mantels, with their spindly turned balusters, and velvet covered recesses, which are generally too large or too small for the ornaments we have, and which require fresh purchases to be made of ornaments we do not want, in order that they may be filled. But, I would have the mantel-piece an important object in the room. We gather round the fire in winter, and have it always before our eyes; why, therefore, should it be formed with the usual tasteless marble framework, which we are so accustomed to see in many modern town houses? In the smaller bed and dressing-rooms, the upper portion may be made useful as a dressing-table, and so save the expense of moveable table and looking-glass; the sides may be of glazed tiles, so as to reflect the heat of the fire and to offer no resting-places for ashes or dust.

In every room of the house I would substitute polished marble or glazed faïence fixed fenders for the ordinary movable iron or brass arrangements, which not only require much labour in cleaning, but hide dirt and dust under them. But these marble fenders must be made sloping in section to the hearth, so as to offer no angles or corners which cannot be easily swept out. I give two sketches, one showing a marble fender of improper section, and as usually sold, and another showing a section which offers no obstacles to the proper cleaning of the hearth.



Section of marble fender as suggested.



Ordinary Section
R.W.E.

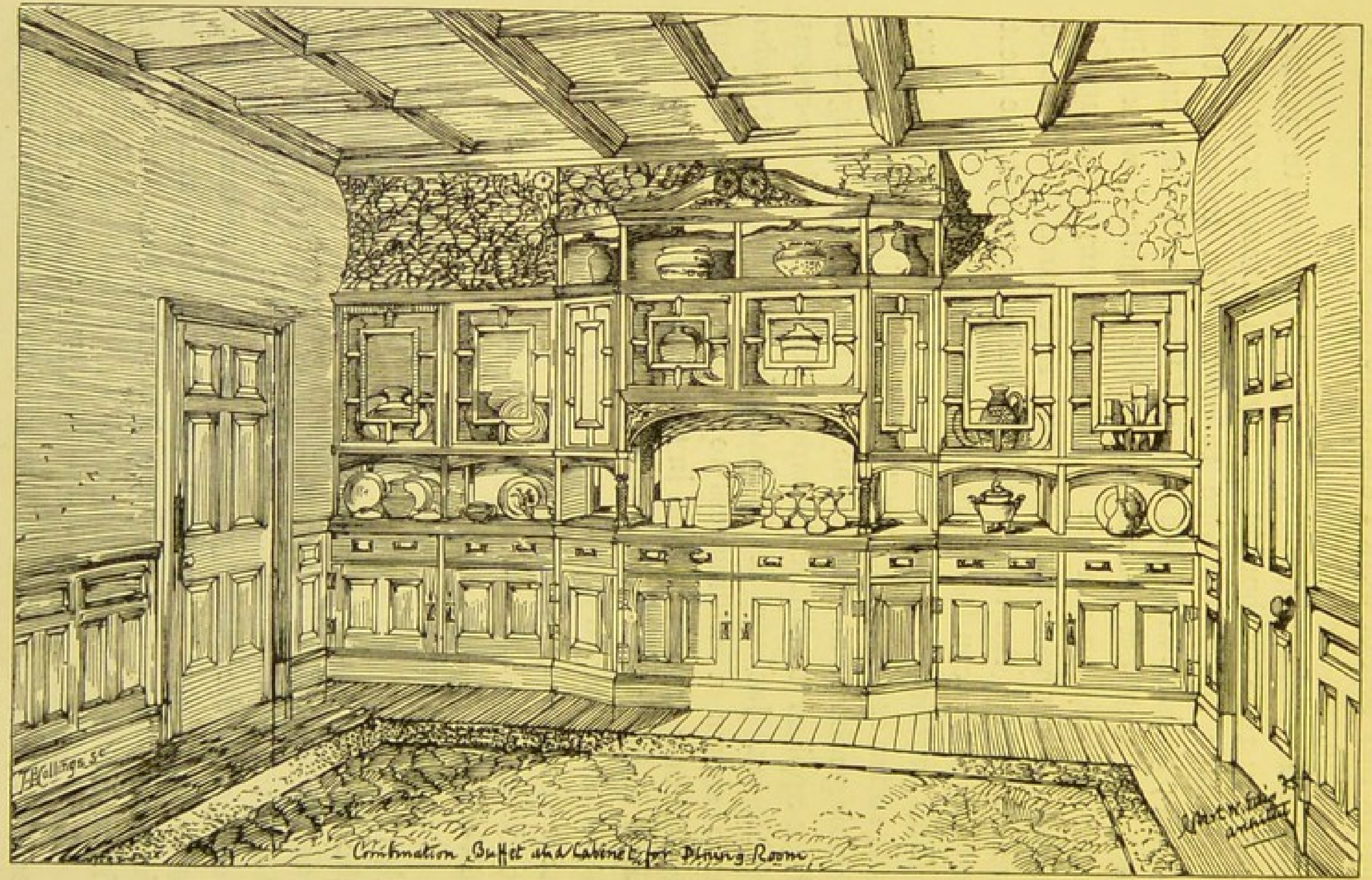
In the dining-room of the house, if possible, a recess should be arranged and fitted up with a handsome buffet, in place of the modern expensive, and, oftentimes very useless, sideboard. It can be made to hold china and glass, with glass cupboards above, and to include a light lift from the basement, with store places for wine and decanters, can be fitted with drawers and shelves for prints or photographs, and, at a comparatively moderate cost, be made a useful as well as ornamental feature in the room, answering several purposes; or the back of the recess might be panelled with centre-glass reflecting the end windows and the table, and adding thus to the picturesqueness of the room. This glass panel could be made, if necessary, to slide, and form a serving hatch from the usual small back room, in most second and third rate houses; but all this sort of work I am aware means time, thought, and design.

Generally, however, the owner is not prepared to give the necessary time or thought to any such arrangement, even if he have the knowledge to enable him to make the design; besides which he does not know, as a rule, unless he be an architect or an artist, how the finished work will look; whereas he can see for himself in any good upholsterer's shop a variety of made-up sideboards, and thus he prefers to buy the ready-made goods and to get the best fit he possibly can for his money.

This practically applies to all questions of fitted furniture, but, so far as the "fitments," I have described for bed and dressing-rooms, he may, if he will, see various designs of these applied to different shaped rooms in the show-rooms of Messrs. Jackson & Graham, in Oxford Street, who have shown a willingness to depart from the ancient upholsterer traditions, and in the belief that my views are fairly sound, and at all events worth a trial in questions of fitted and planned furniture, to carry out various designs I have made, expressing so far as it was possible, in the made-up spaces in a large show-room, the views I have advocated.

I should weary my readers were I to enlarge more upon this portion of my subject. What I have said as regards the constructive fitting up of our bedrooms and sitting-rooms, applies with equal force to every room in the house; that is to say, in the offices, in the hall, in the lobbies, on the landings; but it is useless advocating any such doctrines, if we are content to buy ready-made furniture without regard to its suitableness or general fitness for our rooms.

As a matter of course, all the smaller items of furniture, and carpets, curtains, and small general fittings, must be taken from store and arranged in their places about the house; with these matters I have nothing to do, they will be good or bad, artistic or commonplace, as the taste of



Combination Buffet and Cabinet for Dining Room

J. Hollinger sc.
Albert W. Fuller
Archt.

the individual purchaser may direct; but in these, he or she may nowadays—when taste in design has so materially improved all furniture, crockery, silver, pottery, and glass—safely trust to almost any of the excellent manufacturers, who are supplying their various specialities to the public; and, as the taste of the public, and the sense of sight becomes more educated, and the common-sense of the people insists, first of all, that comfort, healthy treatment, and fitness are essential elements in all those fittings of the house which are not absolutely luxuries or ornaments, we may rest assured that there will be gradual artistic improvement in all the trades which are specially cognate to art, and we shall, when this knowledge and common-sense are applied to our every-day surroundings, as they are to our daily work in life, no longer be content to change and follow a mere fashion and order of the day, and to live in dread of the time when a new fashion, a new caprice, or a new fancy, shall compel us to a change, which is to be condemned on every ground, artistic and common-sense.

For health and comfort's sake I cannot too strongly object to all those smaller articles of furniture, which in the shape of fluffy woollen mats, velvet-covered brackets, and mantel-boards, attract and hold dirt and dust, and which when brushed or shaken add only to the dust elsewhere in the room, and naturally to its stuffiness and unhealthiness.

I cannot understand why so many common-sense people are content to stock their houses with all kinds of unsuitable ready-made furniture. I am told that some people buy ready-made clothing, and perhaps in the smaller things they get very well fitted; " but I fancy in dress most sensible people choose their own cloth and colours, and have their clothing made to suit them, and adapted to particular seasons and purposes. Why not apply the same common-sense and thought to the furnishing of a house? It is all very well to say that almost any kind and character of fittings can be bought nowadays, but, so far as my experience goes, most of the furniture offered to us is made after some particular fashion, good, bad, or indifferent, without reference to its suitability for the place each piece may have to occupy; with all kinds of expensive and unnecessary "trimmings," in the shape of carving, notching, or constructed ornament, and without regard or thought as to its providing inaccessible ledges and resting-places for dirt and filth of all sorts."

I unhesitatingly assert that greater comfort, greater convenience, greater economy of space, greater artistic character, and considerable saving in cost, and general improvement in healthy treatment, may be effected by more thought and less hurry in the furnishing of both old and new houses.

It seems to me that we cannot leave old grooves in the finishing of our houses, and modern builders are content to ignore to a large extent all modern improvements. We still have locks, and door and window furniture, which are a disgrace to any civilized community: composition handles, trumpery finishings, unwieldy sashes, with no means of lifting them, boxing shutters, which are either never shut, or, if they are, necessitate the moving of every piece of furniture in the windows, and which practically often won't shut at all, owing to the arrangement of curtains or window-blinds. We accept the same miserable arrangement of lighting, of bell wires, and of the hundred and one small matters which make up the comfort or discomfort of the house; either those who run up our houses prefer to keep in the old grooves, or do not take the trouble to ascertain and adopt the many inventions which have been brought out in the last twenty years. To do so involves extra trouble, and perhaps a trifling additional expense; but if the public are content to accept the old order of things, the builders perhaps can hardly be blamed for not providing the new.

Within the last few years there has been a great improvement in the make and character of many of the innumerable small fittings which are necessary in every house especially in such small matters as locks, door springs, sash fastenings, and shutter bars—some of the most ingenious of them the inventions of our ever-progressing and ready-witted brethren across the Atlantic—all of these are to be obtained at almost the same cost as the old inferior, and should be, obsolete, fittings, to which we have been so long accustomed.

I have no intention of advertising these special wares, and do not therefore allude to them in detail; but those who have visited the various Exhibitions of Building appliances which have been held during the past few years, and who visit this International Health Exhibition, will no doubt have noticed for themselves the various articles to which I especially refer, and which, if used, will materially add to the comfort of the dwelling.

Where plate-glass is used for glazing, shutters are rarely required, and where they are fitted, are rarely used; but if they are wanted, surely we might adopt some of the more modern systems of light wooden revolving, instead of the old-fashioned lifting and folding shutters, which are often as inconvenient as they are ugly; but to utilize in our own homes all the numerous improvements which have taken place in house fittings, means thought and anxiety to make everything about the house as good, as convenient, and as practicable as possible; elements which, I fear, do not enter into the head of the ordinary speculative builder, whose sole anxiety is to run up in the cheapest possible way a given number of houses, and to get rid of them entirely, or to let them on lease to the unfortunate house-hunter, who has then to provide for himself all the modern improvements, which ought, to my mind, to have been provided for him.

What can be worse in most houses than the wretchedly constructed decoration plaster cornices and centre flowers, of the paltriest design, and the cheapest of cast enrichments? What can be worse than the trashy mouldings, the heavy skirting-boards, or the cheap plaster decoration crowded everywhere for the sake of show and effect? What can be more vulgar, or less artistic, than the cast-iron trumpery balustrading, in imitation of wrought, which fences in our badly constructed stone staircases? What more dreary or monotonous than the everlasting rows of cement balustrading that form the parapets of our roofs, or the commonplace imitations of stone or other construction, which nearly every mere builder's house in London is bedaubed and bedizened with, in Portland cement; or, what more trumpery than the cast brass bell-pulls, the flimsy gas fittings, the composition door-knobs and finger-plates; or what more terrible and heartrending to good servants than the polished steel fire-grates, with stuck-on ormolu, or cast brass ornament, or the vulgarity of the Brummagem fenders, with rows of turned balusters, all involving endless labour in cleaning and polishing? Yet, seemingly, all these shams and absurdities of false construction go on, like Tennyson's "Brook," "For ever;" let us hope that with improved taste and better knowledge of the people, these may soon be relegated to that bourne, whence, let us hope, there is no return. All these small matters materially affect the comfort and enjoyment of the house, and are necessary elements for good or evil, in the shape of peaceful occupation, or constant worry, involving mental friction and annoyance.

If ornamental ceilings are wanted, why not dispense with the old-fashioned lath and plaster, and use more extensively, fibrous plaster, which can be modelled to any design, and be screwed to the joists? All this sort of work is infinitely better than the old system of lathing and daubing two or three coats of heavy plaster on to our walls and ceilings, for, owing to its strength and tenacity, it has no liability to crack, is virtually fire-proof, is rapidly fixed, can be decorated within a few weeks, and saves all the dirt and mess, which, unless great care is used, absolutely destroys all floors, if they are required to be stained or varnished, for the spots formed by the dropping lumps of wet plaster, practically will show through any amount of stain or varnish. This canvas plaster is about one quarter the weight of ordinary plaster. Both fibrous plaster and papier-mache adapt themselves to the ornamentations of ceilings and walls, and can be successfully applied to many purposes; in the building of a house, for instance, for skirting, door architraves and cornices, where wood or common plaster are now used.

I am no advocate for the copyism of any particular type of work, but I confess I should like to see London ceilings, especially in good houses, carried out somewhat after the manner of the delicately designed, and beautifully modelled, examples of the Brothers Adam, as carried out by them in the end of the last century.

Nothing can be more graceful than some of these designs, with their modelled figure and flower enrichments, in very low relief, suggesting all the grace and beauty of delicate Greek ornament, with a treatment essentially fitting for large flat surfaces, and capable of the purest decoration in soft tones, like Wedgwood ware.

All this kind of work can be done at comparatively small cost in canvas plaster, and, when expense is an object, can be repeated with reversible designs in all the principal rooms of a town house; and to a great extent some of this low-relief decoration might legitimately be applied in the friezes of the various rooms, in the panels of doors, and in the soffits of staircases.

Messrs. Jeffreys & Co., of Islington, have made some charming leather papers, in low relief, tinted and gilt, adapted from the designs of old Spanish and Italian leathers, which are admirably adapted for wall and ceiling decoration, and would form a pleasant change to the generally perfectly flat surfaces; the ornament being in very slight rounded relief is not likely to hold dust or dirt, and can be cleaned easily with the ordinary feather brush.

The material known as "Lincrusta Walton" may also fairly be used for wall surfaces, and some of the designs furnished by the Company are very delicate and good: as a non-absorbent, and, I believe, absolutely damp-proof material, it is especially useful in halls and staircases, more especially as, from the nature of the material, it is not so likely to be damaged as wood panelling or an ordinary painted surface.

Thin marble and onyx slabs, and coloured and glazed faïence, may also well be introduced into London halls and staircases, as cleanly, healthy, and decorative; but with the knowledge that every house-designer of the present day ought to have of the great increase of beautiful materials, and useful inventions, which are ready to his hand, there should be no difficulty, with proper care and thought, in improving the interiors of our houses, and making them artistically beautiful, as well as more cleanly and more healthy in their design and treatment.

But all this is hopeless if people are content to live under the present condition of things, to look at sanitation, comfort, and art in the house as mere haphazard luxuries. I can only hope that the views I have set forth may not be thought utopian and impracticable by the bulk of my readers, and that at least I may have scattered seed, which, if it be good seed, shall find a resting-place in some of their minds, and, in the progress of time, germinate and bring forth good fruit.

In the best renaissance houses almost invariably the decoration, furniture, and fittings, were designed by the architect, and were made more or less elaborate, as the taste and luxury of the age required, and in many of the older towns in France, Italy, and Germany, there are still innumerable examples of the vigour and force of internal design in the decoration, panelling, and furniture of the houses, showing the same characteristics as the building, and generally good and harmonious in composition.

The fireplaces, ceilings, and panelling of many of our English houses, still remain to show how intimately the design of the internal fittings was connected with that of the exterior; and I cannot see why the architects of the present day should not make the interiors of their houses, as regards decoration and fittings, as much a part of their study as the mere outside shell work which enframes the rooms; and I am quite certain the taste and knowledge of design, which marks the work of every educated architect, fits him especially for the proper completion of the internal fittings, whether in furniture or decoration, and that it will be hopeless to expect harmony and unity in any work wherein the construction is entrusted to one man, the decoration to another, and the furniture to a third.

The same master-hand and mind should at least have the general control of the work, and I believe if this system obtained now, as it did in the best periods of art, we should have better and more satisfactory results in the interiors of our houses, with no material difference of cost to the client. If the architect be, as he should be, the chief or head builder, working in association with the sculptor, the painter, and the upholsterer, the art-work of his building will, if he be himself an artist having delight in his work, speak more surely than any words, and we may then hope for better buildings, for higher art-work; but he must be able to associate himself with those who can and will aid him in carrying out his thoughts; for, as Mr. Ruskin truly says :—

"Either his own work must be disgraced in the mass of collateral inferiority, or he must raise his fellow-designers to correspondence of power. If he have genius, he will himself take the lead in the building he designs, . . . it rests with him either to repress what faculties his workmen have, into cunning subordination to his own, or to rejoice in discovering even the powers that may rival him, and leading forth mind after mind into fellowship with his fancy and association with his fame," and by the example thus set, and the higher knowledge thus created, by association with his fellow-workers in the world, he may help to foster a more healthy feeling for art in home life, and in teaching, with honest endeavour and loving thought, those who are associated with him, help in the progress of time, to a demand for higher artistic excellence in all trades cognate to art, and to the carrying into all homes, in some slight degree, the grace and preciousness of beauty and refinement; while adding, in a material degree, to the comfort and healthy enjoyment, bodily and mentally, of the homes we live in.

HEALTHY SCHOOLS.

BY

CHARLES E. PAGET,

Medical Officer of Health for the Westmorland Combined Sanitary District;
Hon. Sec. of the Epidemiological Society of London.

"Let us hope that matters of such great moment may not always be considered of less importance than the languages of extinct nations, or the unimportant facts of a dead history."—PARKES' PRACTICAL HYGIENE.

CONTENTS.

PAGE
Preliminary Observations 371
Well-constructed Schools 375
Playgrounds 405
Well-administered Schools 421

HEALTHY SCHOOLS.

It may well be doubted if there be any so important among the very many health-questions of the present day as those which affect the well-being and constitution of the young life of nations, or any perhaps which is more desirable for the consideration of every responsible adult than that which refers to the early educational period of childhood and youth. It is often said, however, that too much fuss is now made over matters which were not thought worthy of so much consideration by our forefathers, and this may be true in some instances, where details have obtained an undesirable prominence over principles ; but it can scarcely be open to question that many of the conditions of life at this end of the century differ in some of their social and educational aspects from those which persisted in its earlier periods. It is not necessary to refer here to the influences and means whereby these changes have been brought about : it is sufficient for the purpose to know that the personal and written histories of the past fifty years bear like testimony to the facts. But belief in these records of the past, which is now quite universal among all of even the most moderate educational standard, cannot but lead reflecting minds to draw comparisons between the present and the past, and to make use of the experiences thus brought down to them in elaborating principles and lines of action, which, if not proof against change in the future when surrounding circumstances will be changed, may be at least as much in advance of the past fifty years as the succeeding fifty years are likely to see altered. And if this be so, then the consideration of an educational or social health-question should not be set aside glibly on the score of inexpediency, but should be fairly met and criticised, so that the experience of the past may be added to and incorporated with that of the present; and that instead of a drag being placed upon the improvement and preservation of health, the principles of action may be improved upon by each succeeding generation to the benefit of all mankind. For sanitary science cannot stand still any more than any other thing which depends upon man's experiences or deductions, and, like any other phase of human life, is approached through as many different lines of thought and practice as any of the most attractive of arts or studies. The consideration of the subject of "Healthy Schools" is likely, therefore, if viewed on grounds such as these, to lead to some profitable reflections, and perhaps to some still more practical results, especially, no doubt, to the advantage of parents and their children, and largely also to the benefit of the State. The enormous increase in educational establishments alone during the last five-and-twenty years, whether owing their existence to private enterprise or to the intervention of the nation, would of itself be sufficient to suggest that in the study of such a change minds of every possible variety might find much for reflection, retrospection, and anticipation. And in the study of the subject it may well be doubted if present consideration, without review of the past and anticipation of the future, would be aught but superficial, or produce results in any degree satisfactory. One thing is certain, that, whether due to public or private enterprise, schools of the present day differ widely in the most various respects from those which were common in the earlier part of the present century; and that these changes are due to conclusive proofs of the unfitness of the latter for the purposes which are required of them in the present day, is suggested by the fact that but little more is demanded of them now than there ever was formerly.

But indeed it may be taken for granted that when the homes and dwelling-houses of both rich and poor were found to be themselves frequently the most dangerous enemies to the valuable and important lives of the families contained in them, it could not be supposed that other houses set apart for the purposes of education should be superior in structure and detail, or that the finger of death would necessarily rest more lightly on them than it did on others. Indeed, statistical evidence points distinctly to the fact that the dangers to the health of youth in former days were real and many, and not suggested by alarmed sentimentalism of to-day; so, too, it may be believed from like evidence that many of these dangers have been removed, and that the chance of life in the most critical period of its course has been very largely increased. When changes were made to improve generally the whole system of dwelling-houses, and to furnish them against the most obvious inroads of low forms of fever, they could not fail before very long to influence the external and internal arrangements of educational establishments; and no sooner did sanitary considerations become matters of concern to the public than attention was naturally drawn to matters which affected those who were not old enough to judge for themselves, either of the immediate dangers to which they might be exposed, or of the damage to their future which might be engendered by unhealthy surroundings. And for the rest, it may reasonably be supposed that efforts made now, even if they fail to accomplish all that is expected from them in the imaginations of enthusiasts, will be, if nothing else, grand stepping-stones which it is the duty of each generation in turn to provide for its successor to approach more nearly to perfection and to the truth. It probably will have occurred, however, to many who read the title of this Handbook that the consideration of "Healthy Schools" would not necessarily, or even wisely, be limited to a review of the conditions requisite for the provision merely of healthily constructed and arranged houses, but that schools usually obtain the reputation of being healthy as much from the appearance presented by their scholars as by the assurances of competent authorities that the buildings and surroundings of the schools are themselves satisfactory. This obvious possibility has been recognised, and the attempt has been made to generally review both these conditions, although the necessarily limited book-space and the vast extent of the whole subject could not but make some of the points considered seem as if lightly dealt with, and oblige some questions to be even omitted altogether. The Handbook, too, is specially intended to act as a guide to such models as are placed in the Exhibition for practical illustration of the whole question, and it would be manifestly unwise to travel beyond the range of these unless it be in matters which hinge specially upon them. The Prospectus of the Exhibition points out that the question will be illustrated in the details of "Buildings for town and country schools; yards and playgrounds for schools; fittings for school latrines and lavatories; heating, lighting, and ventilation of schools; apparatus for physical training, gymnasia; school kitchens; storing of hats, cloaks, &c.: drying ditto in wet weather; isolation of diseases in schools; school infirmaries." As it is not intended, however, that this list of sanitary appliances for schools should suddenly suggest to the mind of the reader the advisability of immediately throwing this handbook aside rather than induce him to wade through the details connected with these points of interest, it may be as well to say at once that each matter will not be written on here as in the above consecutive order, but that the whole subject of "Healthy Schools" will be treated in as simple a manner as possible, and in such divisions of the subject as may perhaps lead to interest in it, and rob it of such "dry-as-dust" technicalities as might prove tedious and wearisome. But, at the same time, it never was intended for one moment that this same Handbook should attempt to suggest that the question with which it deals was not one of the very first importance to each responsible adult, or that whether or not each person had a personal interest in the matter he should not have an interest in the much larger question of "Healthy Schools," which affects the whole well-being of the youth in his own country.

The most convenient arrangement, therefore, of the subjects to be dealt with may possibly be to place them under the two great headings of "Well-constructed Schools" and "Well-administered Schools," as under these it is not very difficult to arrange in consecutive order the specially important details by which they may be exemplified. Moreover, these two divisions may suitably combine all that may be said on the subject from both architectural and medical standpoints, and in such combination perhaps create an interest which the exact analysis of each view separately might fail to produce. This is the result which is hoped for in the following considerations.

WELL-CONSTRUCTED SCHOOLS.

In the consideration of this heading it will be well to bear in mind that public elementary schools, whether "Voluntary" or "Board" day-schools, and boarding-schools, are those which will be chiefly referred to, since all others may be conveniently established on the lines of whichever most nearly approaches in its provisions and means the special requirements of each of them.

The sites of schools must necessarily vary very much, for in large towns it may be quite impossible to obtain anything approaching to an ideal school-site, while in the country it often happens that schools have to be placed in the position most convenient for a widely straggling population. Under any such circumstances, it becomes a very important matter to decide what considerations may or may not be shelved in the choice of a convenient locality.

Put concisely, it may be said that the best site for a school is on high ground, which is well-drained, sunny, and not much exposed. It must further provide a good water supply, and be made quite free from nuisances. Even if the high site be bleak and much exposed, it is at the least better than a low-lying one, in that it runs less risk of being overshadowed from the sun's rays as in a town, and is often more readily drained. It will depend chiefly upon the arrangements and plans of schools whether or not they will have nuisances around them ; but if any proposed site has in its vicinity any nuisance which may create unpleasant odours, it is necessary to have this at once removed, or even to change the site, rather than expose children to the influences of any contaminated air, to which they of all human beings are the most susceptible. Before all things in this connection, it is necessary that every school have an abundant and wholesome supply of good drinking-water. Without it children are deprived of one of their most necessary foods upon which the maintenance of their good health depends. At no other period of healthy life than childhood probably is the want of a "drink of water" so cruelly felt, and no other considerations of school-site should for one instant override this most essential one, if the possession of it be impossible, difficult of accomplishment, or susceptible of derangement. It is important, too, that no school should be built in close proximity to any mill or building where a noisy trade is carried on, nor, if it can be avoided, at the corner of any street where it would be exposed to the influences of cold winds. Moreover, no school should be without a playground or a yard close to it, and fitted for all the popular active games, such as English boys delight in. The muscular system of the body is so large and important a one that it cannot be supposed that perfect health of the whole body can be even maintained, much less attained, if its proper and special exercise be neglected. Active games and pursuits encourage this necessary exercise, and should therefore be provided for. And as regards drainage, it must not be forgotten that this should be very specially and carefully carried out, and that it should be made upon the most approved plans ; for drainage defects which in private houses may be put down to ignorance or indifference, in the case of schools mean culpable negligence.

If a school be not built over cellars, it should be provided with a very sufficient damp-course, so that the floors on the ground-level may be kept as dry as possible. In the country, where space is usually plentiful, it is perhaps better not to have cellars underneath the school-rooms; but in large towns, where land is high-priced, cellars may be found very convenient in the economy of school-space. While it is certainly better not to use the cellars for anything beyond the storage of fuel, yet they may be used as covered play-rooms during school-intervals when the weather is bad, as seems not uncommon in some parts of the United States; and they may also be used as lavatories if the cellar walls and floors be well cemented and kept free from damp. But under no circumstances is it advisable that the cellars should have closets or urinals placed in them, for these cannot fail to foul the air in them; and if the ventilation provided be quite adequate for such offices, it will probably be found that in inclement weather this will seriously interfere with their use.

The floors of all school-rooms and class-rooms should be made with wood rather than with stone or any other material. Apart from the objections to most stone or cement floors that these become worn, and produce dust, and that asphalte becomes soft, the warmth of such floors is much less than is the case where wood is used; for although the heat from the fire-places and stoves may be felt in their immediate vicinity where the former materials are in use, yet the parts of the floor more remote from the fire-places are found to be quite cold. Where wood floors are the rule, the temperature throughout their whole extent is found to be more uniform.

The planning of every school-room or class-room should be such as to provide that no part of it is below the ground level, and that it contains sufficient cubic space for the largest number of persons intended to be in it at any one time, reckoning each child as an adult. In deciding what the room-capacity should be, it is necessary to remember that each gas-burner, if there be lighting of the room by gas, must be included as an adult also, seeing that the effect of each gas-jet is to produce as great or even greater changes on the air in a room than is effected in the same time by a full-grown person. And this room-capacity should depend not merely upon the area, but also upon the height, the means of ventilation and warming, and the general shape of the room. Moreover, no school-room or class-room should be occupied by any one class for more than one hour without at the end of that time a very free ventilation of the room by fresh air let in through the windows and doors. Wherever there is neglect of this most important detail the square-foot space, and cubical space generally allowed *per head* in schools, will be found to fall very far short of that which is necessary for the maintenance of the health of the scholars, and much less indeed than may be requisite for the improvement of their physical conditions. These spaces, for reasons sufficiently obvious, do not come up to the standards that are fit and proper for sleeping apartments, or even sitting-rooms in constant use for long stretches of time, and cannot doubtless be compared with those necessary in hospitals, infirmaries, or sanatoria, where the struggle against disease already in possession can only be undertaken with any chances of success under the most favourable circumstances possible. School-rooms and class-rooms may of course with advantage provide larger space for scholars than the minimum laid down as absolutely necessary, always bearing in mind that these require both the thorough and complete hourly ventilation of them already referred to, and also that constant ventilation which prevents undue closeness during the periods of school-work ; but the circumstances and surroundings of each individual school require for their satisfactory arrangements special and separate consideration and forethought. The successful solution of difficulties in one case may be quite unsuitable in another, where perhaps the only difference is one of degree and not of kind ; and the circumstance of their being placed in the town or in the country may raise in schools apparently identical in all their obvious purposes difficulties which in one or other may prove impossible to be surmounted. For instance, owing to the inability to obtain the best possible site for the erection of school or class-rooms, it may be impossible to obtain for such rooms the best possible light, suitable cross ventilation by means of windows, or even a uniform warmth throughout them, except by an increase of expenditure considerably in excess of that which is usually made. One or other of these difficulties may arise in either the town or the country and have to be met in the best way that may be. The Exhibition will be found to be full of all sorts of appliances and methods, all valuable in affording general information, most of them suggestive in the highest degree. Ventilation in towns may be very difficult to arrange for satisfactorily, owing perhaps to difficulties in obtaining a site perfectly suitable, often to the confined surroundings of that which can be obtained, and not infrequently in consequence of the sudden changes of climate, as in England, where, moreover, the air not only usually requires warming, but may also be dried with advantage. But speaking generally, the question of expense in making suitable arrangements in new buildings, or in altering old ones to suit more modern requirements, is felt to a much less extent in large towns than it is in smaller country towns or in the country itself. And indeed the same will be found to apply in the other most usual difficulties which arise in the same question. It may be said with regard to the air in the schools of large towns, especially in those for the poorer classes, that this is under almost any circumstances better than that which is usual in poor tenements, and this unfortunately is not infrequently the case; but the question in the consideration of suitable class-rooms for such schools should not be whether the air in them is on the average better than this low standard, but how good it may be made to the advantage of the children sent to them for education. The value of the Exhibition in the study of this one question alone will be found incalculable to all those who undertake it, especially if the main points of simplicity, easy adaptation, and assurance against disarrangement of gear be chiefly borne in mind; and the indirect value of it through the individual practical interests of those who thus make use of it will perhaps be increased to an indefinite extent in the improvement of the general health of communities. Much of course may always be done by teachers and masters in each class-room by exercising their judgment in the opening and shutting of doors and windows, and in many other things—as in the encouragement of cleanliness of both person and clothing —which may temporarily or permanently influence the health of those they teach; but without appliances and simple means for doing what is required, even their action may be hampered and checked to the disadvantage of themselves as well as their pupils. The minimum square-foot space and cubical space in the school-rooms and class-rooms of "Board" schools, have been fixed in England by the Committee of Council on Education at 10 and 120 respectively; but it must not be supposed that these numbers indicate the absolute requirements of children even during the short space of time in which they are kept together for the purposes of class-teaching; they have been fixed as the limit short of which actual and immediate injury to health cannot be escaped. Much more than these minimum measurements must be aimed at if health is to be maintained, and, in the case of the poorer classes, if it is to be obtained. Certainly no English public school, such as is generally understood by the term, should provide less than 800 cubic feet for each scholar, and 1000 cubic feet are what *ought* to be given. And even if the means for expenditure in the building of elementary schools be very much restricted, the cubical-foot space should yet be increased from the terribly low allowance of 120 to at least that of 400. Later on it will be shown to how great an extent the air of school-rooms and class-rooms may become vitiated, and what are its effects upon the health and well-being of school-children; but it cannot but be within the experience of all associated with school-work how inefficiently and with what labour this is performed in close and heated air, rendered all the more foul in many elementary schools by the emanations from uncleanly bodies. Whatever be the amount of cubic-foot space decided on, there must always be constant ventilation of class-rooms going on during work-time, and for the requirements of real health the air should, when 1000 cubic feet are allowed per head, enter the room at the rate of 1000 cubic feet during each hour. Neither should the amount of cubic space, however large, be thought sufficient to obviate the necessity for free window-ventilation at the end of any school-work period, be it ever so short, for without such a complete inlet of fresh air the atmosphere of class-rooms cannot be thoroughly cleansed or purified. With respect to the constant ventilation of rooms, the fact may be with advantage borne in mind that the smaller and more restricted the air-inlets and outlets the more certain is the production of *draughts*—the worst form of ventilation, of course, that can be conceived for the young at school. If ventilation is not to be felt as a draught, the restrictions to the entrance of air should be as few as possible, due regard being paid to the condition of the outer air and the clemency or otherwise of the weather. The chief difficulties in the way of continuous ventilation should be found to exist only in the winter months; in the summer there should be none; but at the same time it should not be forgotten that the production of a draught in the summer-time is not less easy than in the winter, since this depends chiefly upon the impinging of a rapid current of air upon a small surface, or the passage of the same between two small or narrow openings. In endeavouring to secure a proper method of sufficient ventilation in class-rooms, several matters have to be considered and taken into account, for it is not enough merely to introduce large volumes of fresh air without ensuring as far as may be that the air is suitably distributed and reaches every recess or corner. Windows are naturally the most ready means for ventilating rooms; and in all class-rooms they should be made to open at the top, and, wherever possible, be placed at opposite sides of the rooms. It is most advantageous that fresh air entering class-rooms should be directed upwards, and this may be accomplished in several ways. Either the panes of glass may be double, a space being left at the bottom of the outside pane, and at the top of the inside one, so that air enters between the panes and is directed upwards; or when the lower sash is raised a board may be placed between the bottom of it and the window-frame so that air passes between the two sashes of the window in an upward direction; or panes of glass in their frames may be constructed so as to open only towards the inside of the rooms. Upon the direction, and the velocity of the wind, will depend very much which windows will act as inlets and which as outlets for the air; but at the same time it is very necessary to provide other means than windows for artificial ventilation, especially when as in England the changes of weather and temperature are frequently very sudden and severe. All inlets for air should be short so as to be easily cleaned, and should be placed at a small distance only above the heads of persons in class-rooms; they should direct the incoming air upwards; and their mouths should be furnished in stormy weather with a covering of gauze, so that the velocity of the air may be reduced in the class-rooms, the single current be broken up into smaller ones, and diffusion of the whole volume be more certainly secured. The air-outlets should be at the highest parts of the class-rooms, but not immediately over the heads of classes, since under certain atmospheric conditions and changes they may become air-inlets. The tendency of the outlets, however, to become inlets, may be in a considerable measure utilised by placing flanges a little beneath them, so that the air as it enters may be cast upwards again to the ceiling before it mixes with the air of the room. The chief air-outlet for class-rooms during winter-time is no doubt by the chimney, but this is so manifestly insufficient for their requirements that other means have to be employed.

It may be accepted as a very good general rule that wherever possible the requirements for area and cubical space should each be met, and that there should be no attempt at a counterbalancing reduction of the one by additional provision of the other. If, however, it be found impossible to provide both in the proportions given, then the "Rules to be observed in Planning and Fitting-up Schools" issued by the "Committee of Council on Education," may be usefully consulted as to the ratios in which they should exist. From them it may be gathered that, "supposing the class-room to be flat-ceiled the walls should not be less than 12 feet from the level of the floor, and if the area contain more than 360 superficial square feet the height should be 13 feet, and if more than 600 then 14 feet." It will thus be seen that in the case of a school or class-room the requirements of health will not be sufficiently met unless the height be proportionate to the area, and that the mere excess of one measurement over another is not held to be sufficient in the making-up of the total cubical space necessary. But, at the same time, it is not intended for a moment that these stated minimum requirements represent what are considered to be generally sufficient; they merely provide against manifest deterioration of health.

The warmth of class-rooms depends on more than one provision, for not only is it necessary to supply warmth by means of fires, stoves, or hot-water pipes, but, as may readily be understood, its retention or dissipation is affected very largely by the extent of exposed wall-surface, and by the thickness of the walls, and the materials used, as well as by an excessive amount of window-space. The means for producing artificial warmth in schools and class-rooms must be determined by the special circumstances of each, for it cannot be supposed that the same means will prove equally satisfactory in large and small rooms, or in those exposed in different degrees to the varying influences of the weather. For smaller rooms it may be found most convenient to have an open fireplace fixed, if possible, in a party-wall, and not against an outer wall, through which much heat is liable to be lost. On the other hand, in large school-rooms a stove open on two sides may be the most useful for diffusing an equable warmth throughout the whole room; but whenever this is adopted the stove-chimney should be carried through a funnel in the roof, and by thus warming the air around it ensure an exit for the foul air of the room, and so be of as much aid to the ventilation of the room as an open fireplace is. If it be considered undesirable to have a fireplace in a small class-room it may be warmed by means of hot-water pipes; but the management of these, so as to ensure their always being in working order, and neither too hot nor too cold, may prove to be no easy matter, and perhaps be the more expensive and less satisfactory plan of those mentioned. Besides, this method ought to be discarded altogether if sufficient additional means of ventilation are not provided to take the place of the ordinary fireplace. That the artificial warmth thus produced, by whatever means, may not be lost, it is necessary to take care that the walls be built of sound materials efficiently put together, and of a proper thickness. Of all materials those only which fall within the usual limits of expenditure and yield the best results are brick and stone—if the former be used the walls must be throughout 14 inches in thickness, and if the latter, then 20 inches in thickness at the least. The thicker the walls, the less rapidly will the varying changes of the weather affect the temperature of the rooms, and the better beyond all doubt will be the health of the inmates. If the area of the window-space be not more than 15 square feet for every 1000 cubic feet of room-space, there will be no danger of this lowering unduly the temperature of the rooms, but it should be carefully noted that the extent of the window-space must be at least equal to one-tenth of the whole area in each class-room.

Wherever possible, school and class-rooms should be on the ground-floor, and especially is this necessary in the case of infant schools; but of course this provision cannot in all cases, as in large towns, be carried into effect. Still the advantage of minimising the noise by having none overhead, which is one of the most distracting trials of school-teachers, will be well worth the consideration of school promoters who desire efficiency in every respect. It is laid down in the rules of the Education Department that no class-room should contain more than 60 children, and that when more than that number are taught in a room this becomes a school-room, and much more provision for space generally is required. The same or similar limits apply also to public schools, where no class-room should hold more than from 40 to 45 boys. Apart from the question of desirability of grouping more than these numbers of children together, it is certain that they are quite or more than large enough to require the constant and unflagging attention during one hour from the teacher or the school-master. The strain upon the nervous system of the latter is enormous if throughout a long term he does his duty, and devotes his time and energies day after day to his scholars both collectively and individually ; and certainly it cannot be right, whilst striving to improve the health of the scholars, to neglect the equally important health of the teachers. For the purposes of discipline, as well as for other reasons varying under circumstances, no class-room should serve as a passage to another, or indeed as a passage to any part whatever of school premises ; and to reduce as much as may be the noise of classes in adjoining class-rooms, the partition between them should be made of lath and plaster or brick rather than of wood alone.

The foregoing considerations apply in all their general terms to schools where either sex is being educated. In mixed schools, however, the sexes should be kept apart when the children have passed the term of infancy ; nor should infants be taught in the same room as elder children, since the training and consequent noise of the former is eminently calculated to interfere with the discipline of the latter, and with the attention which is due from them for the proper prosecution of their studies. The considerations apply, moreover, in general to all classes of schools, whether

Board schools, public schools, or dames' schools ; the differences in them as applicable for one more than another is, as has been previously mentioned, that of degree rather than of kind. And, further, it is certain that neglect of the chief principles contained in them is sure to bring with it either loss of health, happiness, or good training to the children themselves, disappointment and vexation to the school promoters or authorities, and a corresponding discouragement or impairment of interest for the teachers.

In the review of schools of all kinds there are three matters still which affect the health, moral or physical, of children—the offices of schools, the transmission of light through windows into class-rooms, and the form and arrangement of school-desks. In National and Board schools where children of both sexes are frequently educated under the same roof, it is necessary to make very careful and special provisions to ensure efficient and thorough separation of both sexes in respect to the offices, both as to the position in which these are placed as well as to the means of access. The kind of offices is, moreover, a matter for very serious consideration, and one the details of which have not yet been by any means exhausted. The best position for the offices to occupy is outside the school-buildings, certainly not within them, and this may be often managed in the country where space is more easy to obtain ; but in towns the determination of the localities is a matter of much more frequent difficulty. Still, even in them every effort should be made to secure some separation of the offices from the main buildings, and if no other means exist, a passage between them ventilated by windows on either side may overcome the objection to direct communication. It is well to have a covered passage from the school to the offices when these are placed apart from the main buildings, for some children are apt to shrink from facing inclement weather, and would run the risk of harming their bodies rather than overcome their dread of cold. The set of privies or closets for each sex must be absolutely separated one from the other ; but each set may be subdivided by party-walls between the closets at least six feet high, and each closet be furnished with a door and window, so that the ventilation of the whole set may be more general and less restricted than would probably be the case if each closet were to be separately ventilated. Several useful thoughts may well be given as to the kind of office best adapted for the use of school-children. Wherever a good system of public sewers is within a reasonable distance of the school there should be no question as to the adoption of water-closets, and, indeed, even if there be difficulties in the way of joining on to a good system of sewers, an earnest effort should always be made to overcome them rather than at once to discard the method. In towns it should be a *sine quâ non* to have water-closets ; but in the country other means may be more convenient, or, indeed, the only available ones. When a water-closet system is determined on, the immediate following consideration must be as to the kind to be adopted. Children have an almost proverbial reputation for damaging or putting out of joint nearly every form of water-closet, however simple its action. And much of this has arisen from the pleasure they find in playing with them ; forgetfulness after using the closet to flush the pan, due not infrequently to fear of being late in their return to the school-room, but very often due to positive negligence and ignorance ; and indeed from every possible contrivance for misuse which occur to none probably but the budding intellect. The great advantage of the water-closet over other forms is the rapid and early removal of excrement, so that the children may not be subjected to foul emanations from filthy accumulation. Therefore it follows that, if this one system, which is felt to meet most satisfactorily the requirements of schools in this respect, be so liable to injury and to defect, some form or modification of it must be arranged to overcome the likelihood to mishap. For this purpose none seem to so thoroughly and completely meet the want felt as the trough-closet, supplied by some satisfactory self-acting flushing chamber ; and for the study of these there will be found every possible variety in the Exhibition. It need only be said that the closets should be of indestructible material, and the machinery simple and out of the reach of children. In the other arrangements of water-closets and their drains, all those points which are of importance in ordinary dwelling-houses, as soil-pipe ventilation, trapping, glazed and socketed earthenware pipes, good cementing, and good plumbing, are matters of equal moment in schools, and should have the most scrupulous attention paid to them. At the same time, there is no form of water-closet that will not deserve in schools a regular inspection, which to be of any positive service must be made from day to day. The other kinds of closets, especially those most often found in the country, are the dry earth-closets and the ash-privy ; of these the former is infinitely superior—indeed the latter is as much inferior to any other form as is possible, and in schools especially it should only be adopted as the very last resource. The adoption of the earth-closet is preferable for schools in the country rather than in the town, and if supervised regularly by a competent person, will doubtless be found perfectly satisfactory. It is unadvisable to place them under the same roof as the school itself, even when they are cut off from direct communication with the school-rooms by a cross current of air, for their success depends upon the proper and due addition of earth, and this is not easy to ensure at the hands of children. The best form is the hopper-closet, and the various forms of these may be studied in plenty at the Exhibition. All kinds of earth, however, are not applicable to this system ; those which are needed for the purpose are clayey and marly earths, sands and other sorts being useless for deodorising purposes. In default of such forms of earth being obtainable, and also of water-closets being applicable, there appears to be no other course left than the adoption of the ash-privy system. This, as has been said, is by far the most unsatisfactory form, and therefore it becomes very important that the best arranged and best conducted form only should be used, so that the least amount of harm from such a system of filth accumulation be experienced. It need scarcely be said that it should find no place under the roof of any dwelling-house, much less that of a school; nor should it be placed against the wall of the school. An ash-privy placed against a house is in England considered a nuisance injurious to health; the prompt removal of ash-privies so placed is enforced by most English Sanitary Authorities, and it cannot be supposed that the circumstances of schools are so widely different from those of dwelling-houses as to warrant any mitigation of such action. The deodorisation of excrement in this form is intended to be effected by means of coal-ash, which, by absorbing its moisture, reduces the offensiveness of decomposition. The very statement of such a method, so much in vogue in some parts of England, at once indicates the great importance of excessive vigilance and care in the management, for when the emptying of the privy is delayed for more than one week, decomposition sets in at the bottom of the accumulation so as to make in the removal of it an infinitely greater nuisance than it seems to be when left alone. Indeed, it is certain that when removal cannot be done weekly with thorough disinfection of the premises, it had better be effected quarterly or half-yearly, so that the abomination of it need not be experienced more than a few times in the year.

To be inoffensive this form of privy must be daily supplied with an abundance of coal-ash; and in schools, unless the consumption of coal be very large, it is often impossible to obtain sufficient. Then, as not infrequently happens, the deficiency of substance to be thrown into the ash-pit is made up with other matters, as vegetable refuse and the like. These simply aggravate the position, for the whole system depends for its success upon a sufficiency of deodorising material, whereas by adding other matters liable to decomposition, and possessing none of the properties required, a nuisance is created in the attempt to avoid one. The best means of overcoming the difficulties of this really dangerous and unhealthy method is to provide a tub—half a mineral-oil barrel—for each privy, into which such ashes as there may be should be thrown at intervals during the day, and then to remove the receptacle, which is to be accessible only from the outside wall, once or twice during the week. Such a method obviates the disgusting conditions of large midden-pits, and lessens moreover the offensiveness to which all such contrivances are so very liable in the heat of summer and in the changeableness of the seasons. When, however, the supply of ashes is very small, the removal by receptacles should take place daily. All schools where boys are educated should be provided with a sufficient number of urinals, but the supply of these should not in any way lead to a reduction of closet arrangements, and there should be a constant supply of water to each from above to reduce as much as possible the smells arising from them.

All these points referring to the kinds and conditions of school-offices are some of the most important affecting the health of children at school, and it should not be overlooked that the maintenance of cleanliness and order in respect of the offices is certainly not the least one necessary to the maintenance of health in the school. But, besides, there is a possibility of gain to be reaped by the children of the poor in matters outside the school premises, for the force of example reacts in few so strongly as the young, and the advantages of cleanliness and decency as set forth in the regular and orderly supervision of school-offices by masters and mistresses may lead to some amelioration perhaps of conditions at home, often far fouler than is ever seen in schools.

The necessity for the supply of abundant light to school and class-rooms has of late years attracted the attention of many others besides school-teachers. Especially has it attracted the attention of many eminent medical authorities who have been called upon to remedy evils arising from its insufficiency or unsuitable location. And in close association with this important matter is linked another, namely, the form and arrangement of school-desks.

The first details in connection with the sufficiency of light are of course referable to the natural supply; the artificial supply will be dealt with subsequently.

All windows should be of glass set in durable casements, and their sills should not be less than four feet above the floor, so that the light may come in above the heads of the children and prevent dazzling of their eyes and such distraction from work as would result from the windows being placed low down. The window-space should bear a definite proportion to the cubic space of the rooms, and if the walls be of a proper thickness, as previously stated, it will be found that 15 square feet of window-space may be provided for every 1000 cubic feet of room-space without seriously interfering with the arrangements for the warming of the rooms. It is, moreover, very undesirable that this amount of window-space should be reduced, and certainly in towns it never ought to be. The minimum laid down by the State is in England lower than this amount, but it is merely a provision against a positively harmful reduction of the quantity which is advisable. And, further, it should not be forgotten that the aspect of the room must be taken into consideration, for a northern aspect requires more window-area than does a southern; and that, seeing how variable is the state of the weather in England, it is better to make more than sufficient provision for the lighting of class-rooms than too little. If the window-area be found at any time insufficient the windows should be heightened rather than lowered, so that the greatest part of the light may enter the rooms above the heads of the children. The windows ought not to be cut up unnecessarily, as is the case when lead lights and diamond panes are in use, but the panes of glass should be as large as possible, and set in frames which interfere as little as may be with the transmission of light. Under no circumstances should school-children face the windows, for when their eyes are raised from the desks they suddenly encounter a much stronger illumination, which, instead of resting, stimulates the eyes to increased efforts of accommodation, and thus tends to hasten the fatigue of school-work, and eventually to permanently affect the eyesight. The windows should preferably, therefore, be placed to the left-hand side of the children as they sit at work, and that this arrangement is superior to any other may be seen in what occurs when the children are writing. If the light be from the right-hand side the shadow of the hand will be thrown exactly over the spot where the writing should come, and if from the back, then the shadow of the body will obscure the field of vision. In both cases the eye will be constantly strained in repeatedly accommodating itself, for it will have to do so every few minutes even for so slight actions as the looking up from the writing-book to the ink-pot; and it is needless to refer to the many other more complex school-occupations in which this strain upon the eyes would thus be aggravated. But if the light come from the left-hand side it will fall directly upon the desks without creating any unnecessary shadows, and the light falling on it being of the same intensity as that generally diffused through the room, no special effort of the eye will be required to overcome dimness of light, as in the other instances. A by no means unimportant point to be remembered in the lighting of class-rooms is the colouring of the walls, and all the more so is this to be borne in mind when the amount of light is unavoidably reduced from the standard recognised as desirable. Dark-coloured surfaces absorb and retain much of the light which falls upon them; much of the light falling upon light-coloured surfaces is reflected. If, therefore, the amount of light that it is possible to introduce into a class-room be deemed insufficient for the requirements of the scholars in it, the walls and furniture should be light rather than dark-coloured, and, indeed, it may be doubted if it is ever a wise thing to purposely darken any class-room in England. And the economy and quality of the light may be still further provided for and improved by making the surfaces of the room reflecting surfaces, so that not only will less light be lost by absorption, but also that the reflected light will be of a clearer white. The remarks here made refer much more to schools in England, where the weather is often very gloomy and much more changeable than in other countries, and it may be that the latter, with better climatic circumstances, especially in so far as they refer to sunlight, require less provision for securing and economising the solar rays. Each country must provide according to its average conditions ; but, in England, any school falling seriously short of the lines laid down in respect of lighting runs a great risk of injuriously affecting the welfare of the scholars. The provisions in respect of window-spaces, however, which are considered requisite for the average climatic conditions of this country may at times prove excessive, as during those transitory periods when the sun shines strongly. Nevertheless, they can be very successfully met by window-blinds, which do not largely absorb the rays of light, and if these be made to stand out a few inches from the windows so as not to interfere with window-ventilation, they will be found very serviceable in keeping the class-room cooler than it otherwise would be. This seems to be the best stage at which to consider what are the injurious effects upon the eyesight of children through defective light in school and class-rooms. The same considerations will apply under all similar conditions of home work ; but they are not in all probability so constantly in force as they are in schools.

The most frequent affection of the sight caused by deficiency of light in school-life is that of myopia or short-sightedness. Myopia is a disease of childhood and early adult life, and rarely, except under special circumstances, increases after the later date. By it is meant that by some means or other the eye has been rendered faulty in that it is elongated from before backwards to such an extent that the lens of the eye fails to throw the rays of light exactly upon the sensitive retina at the angle at which the rays are converged. This condition is often hereditary, and is certainly increased by general enfeeblement of health and after severe illnesses. The enumeration of these predisposing causes will probably be sufficient without further comment to indicate the immense importance of their consideration in reference to the education of children and young adults; but it may still further impress the necessity of their being taken into serious account by stating that, given any degree of shortness of sight in childhood, this is always liable to be increased by close application to work if left uncorrected or unaltered. If the light thrown upon the desks during school-hours be insufficient or defective, and the work on hand requires close attention, as in reading, writing, and in almost every other class of work, it is certain that the eyes of the scholars will be brought very near in a state of convergence, so that they may see their work. The maintenance of prolonged convergence of the eyes is the condition which is most liable to produce their characteristic elongation, significant of myopia. Other circumstances, besides faulty sight, which lead similarly to the approximation of the eyes to work are books with small or defective type, seats set too far back from the desks, tired backs, and bad habits of stooping. All these have to be successfully met, and it is by no means always easy to do so. Books with bad type can of course be readily avoided, but the regulation of the height and distances between both desks and seats is more difficult of determination. The Exhibition will be found to abound in all the latest improved arrangements in these respects, not only to ensure proper attitudes of the scholars both in reading and writing, but also to economise their strength, and so enable them to do a given amount of work at the least possible rate of extra mental or physical effort. But it may be doubted, seeing how great is the disparity in height between scholars in the same class, if any fixed form of desks and seats of the same uniform height can meet satisfactorily their wants in respect of distances from their work. In large schools, and especially those known popularly as "private schools," where expenditure is less a matter of moment than in National schools, and where care for the health of the scholars is specially considered, it may be that separate desks alterable to requisite distances could be adopted with advantage; but the differences in bodily stature depend so much more upon the length of the legs than of the back that the use of desks and seats calculated to the average sitting height of scholars in each class will probably be found to sufficiently meet the necessities of each one,—only in the determination of these heights it should not be forgotten that the proper distance for books or work to be placed from the eyes is fifteen inches, and that reduction of that distance for constantly prolonged periods leads in children, as before mentioned, to serious defects of their eyesight. If the eyesight of any at school be found defective, that fact should not be taken as a reason for allowing this distance to be lessened in any degree whatever, but should rather be taken as an indication of the desirability of providing suitable glasses for use in such work as would otherwise necessitate undue approximation of the eyes to it. Moreover, in stating that the distance should be fifteen inches, it is also meant that this should be the minimum standard, and that at that distance work should be easy and not difficult of accomplishment. It may create some interest to know that this question of affected eyesight in schools has attracted a very great deal of attention in most parts of the civilised world outside England, especially in Germany; and that the extent of the enquiries instituted in respect of it may be better appreciated, the following investigations may be noted. Dr. Cohn, of Breslau, having examined the eyes of over ten thousand school children in several German cities, found that short-sight in them was exactly proportionate to the duration and extent of their education, varying from 5 per cent. in village schools to 20 per cent. in the higher schools. He also found that out of 410 students of the University of Breslau, no less than 60 per cent. were short-sighted. Professor Virchow, of Berlin, has likewise written on the same subject. In England the subject has received a good deal of attention at the hands of eminent oculists, and similar results to those obtained in Germany have been met with in Russia, America, and other countries. There is, however, another form of defective eyesight, which, when left unremedied, leads, by its connection with close application to school-work, to an actual deformity. This is the opposite condition to myopia, namely, hypermetropia, or long-sightedness, and the deformity which may result from it is that of "squint." The peculiarity of hypermetropia is that sight is not clear even when the eyes are at rest, as opposed to that of myopia, where vision is limited by some fixed point. In hypermetropia, therefore, clear vision can only be obtained by an exercise of the accommodating powers of the eye for distant as well as proximate objects. For perfect sight of the latter, however, accommodation of the eyes has to be exerted in a much higher degree than for the former. For clear sight of near objects, the eyes have, of course, to be converged, and, to neutralize the existing defect of vision in hypermetropia, the lenses of the eyes have to be rendered more convex. This is accomplished by means of small and delicate muscles, whose actions are controlled by special nerve-centres. These same centres, however, are likewise the controlling powers over the muscles which are used in the rolling-in of the eyeballs. When, therefore, the eyes are exercised for long periods of time in close vision, the constant action of the accommodation-muscles involves an equally constant action of the convergence-muscles. The continuous and habitual exercise of the latter tends to make them unusually strong, so that their action overpowers, even when the eyes are at rest, that of the other muscles of the eyeball, with the result that the eyes are always in a state of convergence. The other muscles being also in a condition of disuse, become weakened and less and less able to resist the action of the converging muscles, so that the step from moderate convergence to extreme convergence of one or both eyes is not a difficult one. But when a child suffering from hypermetropia desires to look attentively at a near object, it has to make an effort of accommodation, and in so doing makes a corresponding effort of convergence. This convergence is apt to become greater than need be, for the eyes start from an already-acquired condition of convergence, and not from that of natural parallelism, the eyes being thus directed short of the object and vision rendered indistinct or "double." To neutralize this result, one eye has to be diverged from convergence, so as to see the object ; and, as as a matter of fact, the other eye is turned inwards to a greater extent than it was. When this abnormal condition of things is persisted in, a "squint" becomes permanent, and it therefore follows that no school-work should aid in producing so serious a detriment to the welfare of the future life of children. The condition of hypermetropia, and its tendency to produce "squint," may be treated in so simple and effectual a manner, that when such defective sight is once discovered it should be immediately provided for. As in the case of myopia glasses are necessary to obviate the eye-defect, so in hypermetropia are spectacles required ; but the difference between the requirements of the two conditions is that in the former glasses are wanted to enable the eyes to appreciate what exists beyond their fixed point of vision, in the latter that they may be employed without detriment in close vision. In both cases, however, the glasses supplied should enable all school-work to be done at no less distance of the eyes from it than fifteen inches. And in drawing deductions from some of the enquiries made by competent authorities, it is well to see how far they may prove useful for the early detection of defective sight, and so lead to provision being made against any serious extension of mischief. For this purpose it would be well that children on entering schools should have their eyesight ascertained by means of "test-types." This is not unfrequently done in the homes of those of the richer classes, whose medical practitioners are quick to detect imperfect sight, or whose long connection with medical men enables the latter to forecast the probabilities of defective sight, and therefore to be on the outlook for it; but it is far otherwise with the poorer classes, whose means do not permit of their frequently consulting doctors about their ailments, and who on that account often avoid doing so until their defects are difficult of remedy. And it should be noted in this matter that unless teachers are very watchful of those under them, these eye-deficiencies are very apt to escape notice altogether, for though hypermetropia causes aching of the eyes, yet the onset of short-sightedness is unattended usually by severe pain, and the aching of eyes in children is too common to cause them any more concern than a desire to rest. Did it alarm them, the insidious onset of the defect would be sooner recognised. Under such circumstances, it may surely be considered advisable that in schools for the poorer classes some system should be adopted whereby defective sight might be discovered early, and that thus such schools should not suffer in reputation as to the health of their scholars. When discovered, the wearing of suitable glasses should be encouraged.

It yet remains to say a few words with regard to the artificial lighting of schools and class-rooms. In England this is usually accomplished by means of gas-jets most often hung from the centre of the rooms. The more imperfect the light the lower it will be hung, so as to prove sufficient, and the greater is the amount of heat that will descend upon the heads of scholars; the better the light, the higher it can be fixed, and the smaller will be the amount of heat to affect scholars injuriously. The consequence of having much heat thrown upon the head is to cause congestion of the head and of the eye, and this will be found to lessen the amount of work done, for throbbing heads and aching eyes are manifestly less capable of continuous work than their opposite conditions. And further, it may be stated that congestion of the eye, together with prolonged close application to work, will, wherever a tendency to myopia exists, inevitably hasten that condition, the which it is the duty of all school authorities to check in every possible way. For the general lighting of school-rooms gas is found to be the most convenient and the one most easily adapted to the requirements of school-work; but seeing how very bad the lighting by gas may be made from want of care and attention, it becomes important that this form of lighting should be very carefully watched and supervised. It is not the amount of gas burnt that satisfactorily meets the requirements of schools, but its quality, its disposition, and the brightness and clearness of the light produced, and it may be taken for granted that there is much room for improvement in these respects, if, when the gas-jets are at the distance of five or six feet above the heads of scholars, the light be found defective for school-work.

Closely connected with the consideration of the lighting of school-rooms, as has been said previously, are many important details respecting school-desks and benches. The subject has been referred to in its bearings upon the causation of shortsightedness, but it will be found that to a much greater extent various other kinds of school ailments, which by due regard being had to their methods of production, can very readily be avoided, are directly influenced through the same means. It has already been pointed out that desks and benches should be regulated to the requirements of each class, and this may be best accomplished by graduating them to the ages of the majority in each class, or to their average sitting height. Where the desks and benches are of long lengths, it is very doubtful if any other method of determining the general wants of a class in this respect will meet with better results than may thus be obtained, seeing that the differences in height are most noticeable while children are standing rather than when they are sitting. But where separate desks and seats are provided for each scholar, then the differences of distance between eyes and work can be more accurately adjusted throughout the whole class. The amount of desk-space for each scholar should not be less than eighteen inches in length; but it may with advantage be six inches more than the minimum. It should not be forgotten, however, that whatever be the length of desk-space for each individual, the whole length of the desk should be some multiple of the space determined on. The regulations in respect of desk-space apply equally, of course, to the bench-space, and it will be found advantageous to have the seats 12 inches wide rather than any less measurement. The depth of the desks may vary from 15 inches to 2 feet, but anything over this latter will probably be found inconvenient for any scholar. The form of the desks is a matter of very great importance in connection not only with the production of myopia, but also in respect of more than one other school ailment, and is one which has given rise to a great deal of discussion and thought, and in which improvements may even yet be expected to be made. Speaking generally, it may be said that desks and benches should not exceed 12 feet in length, and that no group of desks should consist of more than three rows. Especially is this necessary when two or three classes are held in one class-room, for it will be found that in proportion as the depth or length of the distance intervening between master and pupils is increased, so will the former have to raise his voice to a higher pitch; and this is of course exhausting to himself. But still more is it undesirable when as supposed the class being taught is one of others in the same room, for the master is led into adding unnecessarily to the general noise, distracting to himself, disturbing to the general school-work. But when classes are held in separate class-rooms, as is so common now in large public schools, the desks may be increased in length to 18 feet, and the number of rows may be four without causing inconvenience either to the master or to the scholars. In National schools it is usual to have a passage 18 inches wide between contiguous classes, and in some instances they are separated by means of a hanging curtain. At the same time, no group of desks should be so arranged as to provide for a passage only on one side of the group; and even in class-rooms it will be found to add very greatly to the convenience of all engaged in them to have similar passages running between either ends of the desks and the side-walls of the room. The main question for discussion in regard to desks is whether they should be made quite flat or be inclined. The chief objection to the latter, and especially in schools where young children are taught, is that pencils, pens, and the like will be constantly slipping off, leading to noise and interruption of work and to the perpetual annoyance of the teacher. Moreover, in public elementary schools, where not uncommonly, as at dinner-times, they are wanted as such, the desks if sloped cannot be used as tables. On the other hand, the objection to their being flat is that it creates a tendency to "stooping" among children, and is one of the causes of some school ailments. How all these objections may be best met is well worthy the study and consideration of all who are interested in questions of school hygiene, and if that study be carried on now at a time when so many methods and appliances are on Exhibition to meet so far as may be practically suggested the wants arising out of them, it is not likely that the time thus spent will be wanting in fruitful reflections, or be found eventually to be time wasted. The object of the Handbook being only to incite interest in the subject, and to lead to some such study which may be of practical utility subsequently, while at the same time affording an interesting amusement, only general considerations on the subject will be discussed or pointed out, so that the details exhibited may speak for themselves, and that comparisons between them may be arrived at through independent judgment. The questions arising out of the subject of school-desks are chiefly those which refer to the health of school children, and therefore it may be well to consider these as a means of arriving at conclusions respecting the form of desks most suitable for their prevention. In the first place, however, it should be remembered that the ages of childhood and puberty are specially liable to the contraction of ailments and physical mischiefs; and further that girls suffer at these ages much more than boys do. The advent of puberty seems to increase the liability to disease in both sexes, especially during school-life, very largely ; and it appears also on the evidence of more than one authority that this is particularly evident in the case of the female sex. The chief troubles arising from faultily arranged school desks and seats may be conveniently stated as being, in addition to the indirect effect upon imperfect eyesight, spinal curvature and headache with congestion of the brain. It will not be very difficult perhaps to show, even without the aid of diagrams, how these may be brought about. Few can have failed to observe the very constrained attitude assumed by young children on first attempting or learning to write ; the right shoulder is raised, the arm thrust forward, and the back curved laterally instead of naturally. It is remarkable that the same position is that very frequently observed among children who attend schools, and even in those who are taught regularly at home, but who are allowed to assume attitudes which lead to deformity. It is not every child, of course, who acquires this curvature of the spine, and it may be that, with the exception of the very studious and those who are kept closely to their work, it only does appear where there may be shown to be some hereditary taint of a debilitating disease or some evidence of disease acquired during childhood, whether independently or as a sequence of a severe fever or illness. But it is then, if at any time, that the greatest possible vigilance and supervision should be exercised to prevent the tendency to production of spinal curvature, and for this purpose great care should be taken that the obvious aids to the production offered by desks and seats made on ill-considered lines should be avoided. These are, as has already been shown to be the case in their influence on shortsightedness, desks and seats ill-arranged in respect of height so that scholars have to stoop over their work, flat desks, and an undue distance of the seats from the desks. It has been shown how the first of them may be avoided by graduating the seats and desks according to the ages of children in classes ; but it is now to be considered how the two latter may be overcome. Flat desks are very unadvisable owing to the almost certain inducement which they afford to all children, and especially the weakly ones, who readily become tired, to habits of stooping. It has also been mentioned, on the other hand, that in most schools for the poorer classes these are very frequently useful if flat to serve as tables. It will perhaps occur to many that this is a very minor consideration when compared with the more obviously important one, but it is one which cannot be readily overlooked when the amount of expenditure and how much can be provided with that permitted, have to be taken into account. On the whole, therefore, it may be stated that a *slightly* inclined desk will be found to meet most of the difficulties of this matter, in the first place because even a *slightly* inclined desk will considerably interfere with comfortable stooping, and secondly that if it be not very much inclined it will not seriously interfere with its use as a table. Pencils, pens, and the like, need not be continually falling off inclined school-desks if the ends of the incline furthest from the scholars be made flat for these to lie on and for ink-pots to be fitted into. In schools where this plan of desks is now in use little or no inconvenience appears to have arisen from the adaptation to use as tables, and it most certainly has proved very useful in assisting to prevent the tendency of scholars to stoop and assume deformed attitudes. It should be remembered, moreover, in connection with school-desks that there should be no ledge along their edge which is nearest to their corresponding seats, as this has always been found to interfere with easy writing by cramping the arm; and its usefulness in keeping rolling articles still on the desks, may be made up for as shown above in the flat top of the desks. Again, it has been said that an undue distance of the seats from the desks tends to produce habits of stooping at work, and this is so manifest as to need no elaborate explanation. It may be wondered indeed if such does even exists in schools at the present day, and if so how it came about. The explanation of it lies in the fact that it is sometimes customary for children to be taken in classes for repetition work at the seats where they write, and in the performance of the former work it is usual for them to stand up. It is obvious therefore that for this purpose the space between the seats and desks must be sufficient for the children to stand with some degree of ease, and as the seats are frequently secured to the floor, the space which is sufficient for their repetition-lessons proves detrimental to them in their desk work. The objections to this distance may be overcome by either leaving the forms loose or else by requiring the class to leave their seats and stand, or else sit on other forms arranged before the teachers. The latter plan is often, too, the more preferable, and is adopted at the present time in some of our English public schools; and the former may certainly be considered undesirable in National schools owing to the noise of the moving back of forms, and in so doing perhaps the upsetting of them. The difficulty is one which has arisen more possibly from motives of economy and from want of forethought than from any other cause, for no one probably finds it easy to stand up in the exact place where he has been sitting to write. But at the same time it is all the more important to be guarded against in the future, and any extra provision of forms will be found to amply repay the first outlay by conducing to the better health of the school children.

Both headache and congestion of the brain may be produced, and often are, by the same faults in the regulation of school-desks and seats which have been pointed out as tending to induce stooping, and so assist in causing spinal curvatures. This is obvious, but the indication may be carried still further as another reason why, when defective eyesight is noticed in a scholar, suitable glasses should be worn, for, even with well-regulated desks, if this eye-defect be such as to be insufficiently met by the height of the desks, stooping will still take place. The headache is as often, or more so, produced by bending the head over books as by overwork, for the blood, which is unduly carried to the brain, is at the same time retarded in its onward course from it, and therefore, though not stagnant, yet moves sluggishly and oppresses the brain, causing headache. If the head be held fifteen inches from work this tendency to congestion of the brain is very much lessened, at any rate, it is not caused by obviously physical means ; and since in children liable to show evidences of some forms of illness, hereditary or acquired, as of struma, this is likely to aid in the production of sickness which may be put down to other causes. For this reason, if for no other, every possible means should be used to prevent the stooping over work of school children.

PLAYGROUNDS.

But in the majority of schools there exists something which very largely aids in counteracting the evils which are so apt to arise in consequence of faults in school construction, and this is, it is almost needless to say, the playground of the National and dames' schools, the "field" or "green" of the public schools. Were it not for the opportunities offered for active out-door exercise, some school ailments would become much more common than they now are. Indeed, it may be believed that as much has been done by making playgrounds matters of necessity in the construction of schools, as in the improvement of internal school arrangements, since the reaction of physical exercise on school work is of the most healthy kind, and school games especially have a most healthy influence upon the quality of school work. For, as in England, school games are of such an absorbing nature, and require so much skill and attention for their success, that the mind is forced to concentrate itself entirely upon them, and has therefore no time to think of indoor studies. The effect of such exercises is to induce habits of earnestness of purpose, and imprints its mark very generally upon all school work. "Good at work, and good at play" is an almost household word in England, because the successful accomplishment of either cannot be attained without an entire engrossment of mind as well as body, and is therefore held up as the aim of every English scholar. It matters not whether they be boys or girls, the same exercise should be common for both sexes up to the age of puberty, nor should there even at that age be any sudden change made in the case of school-girls. The health of girls at school does really depend very much upon the physical exercise which they take, and the rest which should, if possible, follow it. The circumstances of the rich and poor necessarily make differences in the possibility of adopting fixed rules for all classes ; but some points in connection with one or other of these may be usefully considered in their relation to the general question. Taking it for granted that no one would question the advisability of allowing girls the same freedom for exercise that is accorded boys up to the ages of thirteen and fourteen, the considerations will refer chiefly to the period of life after that age which might be spent at school. The children of the poorer classes do not remain at school as a rule over the age of fourteen, unless it be for the purpose of eventually becoming school-teachers, and the changes in the school-life of girls entering upon their preparation of such duties are greater than are generally suspected. Those who are chosen to fulfil the duties of school-mistresses are the cleverest girls in a school, who commence their period of training by becoming pupil-teachers. The duties of these consist in teaching the children of schools through all the school-hours, and after that work is done in preparing for their own examinations, which have to be passed in due course. It is easy to see that by such means the young girls are likely to become overworked at the very time when they ought to be husbanding their strength and have plenty of recreation of an active physical nature. They not unfrequently lose their health, become pale and anæmic, and, according to some authorities, consumptive, for the simple reason that the strain upon them is greater than it should be at the age of growth, and that opportunities for healthful reaction on mind and body are, by the force of circumstances, denied them. Youths, on the other hand, though very liable to be similarly affected, yet manage to get some fresh air and exercise, their health not being subjected to the influences of so profound and great modifications as take place in the opposite sex. The want of time with them is made up in great measure by the activity of their exercise, and so they escape the effects of their training more easily than do young girls. Again, among the girls of the wealthier classes want of suitable exercise is often caused by the strictness of school *régime* and by a deportment education, which is supposed to be necessary. Such girls, however, to be healthy, should be allowed to train their bodies in as active a manner as they can ; for if boys require to exercise their extensive muscular system for perfect health, it cannot but be equally necessary for girls to do so to a corresponding extent. There can be no harm in girls playing "lawn-tennis" out of doors, or exercising themselves with calisthenics indoors ; and it is quite certain that they are more active for so doing, and thereby assist materially in the proper and natural development of their form. At any rate, experience teaches that if their exercise be limited to the "two-and-two" walk, they grow up indifferent creatures, quite unfitted for the duties of maternity. And it may not be out of place to draw attention to the fact that it is as unadvisable to encourage the keeping of girls'-schools in towns as it is of those for boys ; but nevertheless it is the case that girls'-schools are more frequently to be found in large towns in England, as, for instance, in London, than are boys'-schools. If the necessities for active exercise are equal in both cases, then the opportunities for taking it should at least not be widely different. The difference in the conditions requisite for perfect health between boys and girls is one of degree and not of kind ; girls cannot do without physical training and development if they are to become healthy mothers of healthy children, and if the significance of these facts be taken into account in the framing of school regulations, the results cannot but be satisfactory to parents and to communities.

The next question to be considered in connection with

Healthy Schools is one that has not a universal application to schools, as it concerns only one class of them. It does, in fact, only refer to that class known under the general term of boarding-schools, though this may even further be sub-divided into "private" and "public" schools. The National schools do not provide sleeping accommodation for scholars, as they are eminently "day" schools, erected in districts where schools are wanted for the poorer classes, and which are conveniently located in their midst. The schools of the more fortunate classes, other than day schools, may, however, be termed establishments for the whole educational career of boys or girls from childhood to commencing man or womanhood, since for the completeness of this and the inculcation of a spirit of independence and self-reliance it has been found convenient that such scholars should reside on the premises of the school, and be trained by other than direct home-influences. That which is now about to be discussed here is the matter of school-dormitories in such of their school relations as may seem to be applicable to the title of this Handbook. And it is surely a very important question this of sleeping-rooms, whether in schools or elsewhere, when for a period of eight or more hours children are lying unconscious, perhaps without the means, and certainly without the knowledge, necessary to effect such changes of the air in their sleeping-rooms as ought not for health's sake to be neglected. Even more than in the school-room or the class-room, responsibility hangs heavy on school authorities to provide such means for constant and suitable changes of air in dormitories as shall ward off the risks to health arising from their closeness. And at the same time it is important that such ventilation be obtained without the undue exposure of scholars to draughts or chills. The division of boarding-schools into private and public has been made purposely for a comparison of the sleeping arrangements most usual in both with each other, although, as is well known, the difference between the two kinds of schools depends much more upon the numbers of their scholars than upon any great difference of school arrangement or management. Both have, however, certain requirements in common which may be stated first. There appears, even now, to be a rather wide difference of opinion as to the number of cubic feet necessary for each child's sleeping-space, for the amounts stated vary from 500 or 600 to 1200. But as it has been already pointed out that 1000 cubic feet per head is the amount proper for class-rooms where boys are congregated for only comparatively short periods of time, it is necessary to provide them with 1200 cubic feet for sleeping accommodation, even with the addition of constant ventilation whereby the air that they respire may be renewed. And this amount cannot be called excessive when it is considered for how long a period it is subject to vitiation. If any less amount be provided it will most surely entail the adoption of some means for ventilation of a most elaborate and expensive nature, which, besides being liable to fall out of gear, will hardly prove so effective as simpler but more gradual methods. At the same time, for ventilation to be of any positive good in dormitories, it must enable fresh air to enter at the rate of 2000 cubic feet per head per hour. The sleeping arrangements in private and public schools vary chiefly in this respect, that in the former scholars are placed in rooms in small numbers—from one to half-a-dozen—while in public schools it is more common for them to be grouped in larger numbers—as from twenty to twenty-five. It is very hard indeed to say which of these plans is the most satisfactory to the scholars, and the question as now discussed will refer only to boys' schools. That smaller rooms are so much in vogue at private schools is due very largely to the fact that these are mostly established in private houses not originally built for school purposes. On the other hand, in large public schools, and in some of them most recently built or altered, large dormitories are still preferred. Both have advantages, and it may be believed that both have disadvantages. The smaller rooms are very useful, no doubt, in regard to checking the spread of contagious diseases, for the reason that not more than three or four other boys are there specially brought into close contact with the original case of illness, and it is stated by those able to judge that there is less liability to bullying in smaller rooms. On the other hand, it has been successfully proved that immediate isolation of infectious sickness arising in schools where large dormitories are in use has successfully checked extension of disease in those dormitories, and certainly it may be believed that there is less likelihood of perpetual and constant bullying by a clique in large rooms, where the influence of several sets may be brought to bear with good sense and manly spirit. Again, the special question of morality, which is so frequently commented upon and discussed, is a very difficult one to deal with, and is liable to be interpreted in the most various ways. It is, of course, profoundly affected by the internal arrangement of the dormitories, or, in other words, it becomes a question whether it is desirable to leave the dormitories quite open or to divide them up into cubicles. It will be possible, perhaps, to find almost as many and authoritative advocates for one system as the other, and it certainly cannot be settled offhand, or even satisfactorily argued in the limited space of this Handbook. Whenever the question has to be decided, it must be viewed on each occasion as circumstances may require; but, if it be worth the record, the writer's experience of delightful school-life in a large English public school has been to make him an advocate for the large dormitory and cubical system. It certainly never happened that infectious illness spread from cubicle to cubicle, or that the liability to bullying was in the slightest degree increased. Indeed the freedom in large dormitories is much greater than can ever be in smaller rooms, and the many varieties of character that boys are thrown among in the former tend to induce in them habits of self-reliance, and to free them from the shy hesitancy which is most often the outcome of fear or cowardice. And with the increase of manliness of spirit it may certainly be doubted if the morality of school-boys, which has so serious an influence upon their future careers, is viciously affected by the cubical system. Before it is condemned it must be proved to be a bad system, and as yet the evidence is certainly wanting to show that the health of boys at school has been deteriorated by it. When once it has been satisfactorily proved to be injurious it should be discarded ; but it may well be left till then to show its usefulness in developing manliness and self-respect.

In all schools where boys or girls have common day-rooms, every care should be taken to keep the air of these as pure as may be possible. School-classes should never be held in them if they are to serve the advantages of sitting-rooms for scholars ; it is quite sufficient if day or night preparation-work be done in them. For if after the holding of a class in them the condition of the weather were such as to prevent out-of-door exercise, the scholars would be obliged to remain in the same room with air more or less vitiated, instead of being able, as they ought, to go into one entirely fresh. Moreover, although it may not be possible to avoid it, it is undesirable that meals should be taken in the ordinary room ; but if these must be, then the subsequent thorough cleansing of the air of the room should be effected by immediate and complete ventilation through the windows. The cubic space for each scholar in the day-room should be not less than 1000 feet per head ; and the ordinary ventilation of the room should provide for the entry and exit of 2000 cubic feet per head per hour. The same regulations apply equally to the requirements of private studies whenever these are in use, since the length of time spent in them over any work varies from one to two or more hours.

A by no means unimportant matter in the consideration of healthy schools is the question of baths ; and this, as the foregoing matters do, refers especially to the health of boarding-schools, whether private or public. Attention to the skin is a matter of the highest importance in the economy of the human frame, and one which cannot be omitted from any question of personal hygiene. It must be always kept perfectly clean in addition to being warmly clothed; and in large schools, where numbers are great, regulations must be made and enforced for its thorough cleanliness. Without cleanliness of the skin there cannot be perfect health, nor even tolerable health; and provisions must therefore be adequate and sufficient to ensure skin cleanliness in schools at all times of the year. The best means for keeping the skin clean are by cold bathing and friction, and these should be employed daily. When schools are situated in the country it not unfrequently happens that they are placed near a river, and bathing in this during summer months is of course the most delightful form of bath that can be had, provided that the river is a safe and clean one. But in the winter, when it is too cold for those who are young to run great risks from exposure, some other means must be found to take the place of the summer bathing. It is becoming a very general practice now to erect swimming baths at large public schools, and for private schools to make arrangements with neighbouring swimming baths for winter use. This practice cannot be too highly commended, for the continued effect of cold bathing throughout the year improves apparently the nutrition of the skin, and, when to it is added friction to increase the after-glow, the colour and texture of the skin show manifest evidences of improvement. It is not necessary for swimming baths to have quite cold water in them during winter time; indeed, they are probably more suitable if supplied with tepid water—about 70 degrees Fahrenheit—so that the fear of cold water at that time of year may not interfere with the usefulness of the bath. Evidence goes to show that swimming baths containing tepid water are very much frequented by all English schoolboys during the winter months, to the manifest good of their health; and it may be well that after such bathing they should be obliged to walk or run back to their school-houses for some little distance, so that the healthful effects of the bath may not be immediately lost on their coming out into the colder air. At some English public schools, too, the custom has been adopted of supplying hot coffee in the swimming-baths after bathing has taken place, and this beneficial arrangement may well be adopted in all others, for it cannot be doubted that it helps very largely to the enjoyment of the bathing, and to the protection of young lads from subsequent exposure to cold. When such swimming-baths are not in use during winter, it will be found necessary to make other arrangements for cleanliness by bathing, and this often becomes difficult in large schools. Cold morning baths cannot be provided for all at the same time, nor even conveniently at any time during the middle of the day, and for these reasons perhaps it is that the warm bath once a week in the evening has been introduced into so many schools. But even then, there should be no interference with cold water sponging from hand-basins in the morning, and, if possible, the warm baths should be increased to two per week rather than restrict the cleansing as frequently as may be of the *whole* body. Indeed, this is the pith of the matter, that no true cleanliness of the skin is certain or possible without thorough and entire washing of it at least once in every day. This should be the end aimed at, if it were only that it improves so remarkably the healthy tone of morality in boys; but when, in addition, their physical health depends largely upon its being carried out, every effort should be made to render it possible; and, further, no school should be called a healthy school which does not provide some regular means for its accomplishment. It has yet to be proved that the regular use of warm-water baths has a beneficial effect upon the healthy body equal or even approaching to that which is obtained from the use of cold baths, and certainly in schools it is very advisable that for the purposes of healthy bodily reaction, the warm bath should not be taken unless it is followed by an application of cold water, such as may be obtained from the ordinary shower-bath, or from a large india-rubber tube fixed on to a cold-water tap. Warm baths are more liable to lead to catarrh in susceptible youth than are cold ones, and when to this fact are added the other advantages of the cold bath, its adoption should always be very carefully considered.

Lastly, in this division of the subject—Well-constructed Schools—should be discussed the matter of separate buildings, or arrangements of parts of buildings, as school infirmaries, or sanatoria. These are, of course, wanted only for boarding-schools, since day-schools do not require them. Private schools are frequently not large enough to provide special means for the isolation of infectious sickness arising in them, but have instead to make as efficient provision as they can, and at least as much so as is generally adopted in private dwelling houses. But no large public school should be unprovided with special buildings set apart for the treatment of such illness occurring in them as might at any time prove sufficient to interfere with the general school-work by the spread of it throughout the whole number of scholars. Private schools ought to set apart at least one sick-room for the treatment of ordinary cases of illness and accidents, and to isolate not less than two adjoining rooms with offices for the care of infectious illness. Such provision should be made equally for girls' as well as boys' schools, since both are liable in the same degree to interference with their good health from want of isolation of infectious sickness. And the isolation of the rooms cannot be considered even fairly complete unless the whole set be cut off by means of a single door from the rest of the house, the key of which should be in the possession of the nurse in attendance on the case, so as to prevent direct intercourse with any of the healthy inmates of the house. For the purposes of large public schools, however, elaborate buildings are now planned as sanatoria, since it cannot be overlooked that such schools are often as large as villages or small townships, and are separate communities, obliged to protect themselves, as well as the public around them, from extension of disease in either direction. The ordinary forms of sickness and accidents may be best treated in the "sick-room" of the several masters' houses in connection with the school; but the immediate separation and complete isolation of cases of infectious illness can only be properly effected by their removal at once to a building set apart for their reception and retention until convalescence is so far advanced that it is safe for them to mix with healthy persons. There will be found in the Exhibition models illustrating the best known methods for effecting such isolations, and the details necessary for their efficiency. It is perhaps needless to say that if when infectious sickness arises in a school, means are not at hand for checking its advance, and are not capable of being put at once into action, the most serious results to all concerned in that school may be surely expected; but it is a truth that, nevertheless, cannot be too strongly impressed upon all school authorities. The necessity for making such provision will be admitted, no doubt, without question, and it therefore only remains to discuss what may be the best kind of sanatorium for the purpose. The form of school sanatorium that has been most frequently in use is a single detached building suitable enough for the treatment of one kind of infectious illness at a time, but quite unfit for the simultaneous treatment of more than one. But seeing how large some public schools are, it is at least reasonable to suppose that they are as liable to the occurrence in them of two diseases at the same time as any other community of the same dimensions, and it therefore becomes advisable that provision should be made in them for the treatment of, at any rate, two infectious diseases at a given time, rather than that they should be unable to do so. This cannot be satisfactorily or certainly accomplished within the limits of a single building, although a plan for effecting fair isolation may be described. It is obviously impossible to secure the proper separation of a case of scarlet fever from one of measles if the rooms in which they are located open on to a common lobby, or are attended by the same nurse, or by two nurses who have means of intercourse with each other during the period of illness. And, therefore, if the same building be used for the treatment of two illnesses at the same time, some very systematic arrangements must be made within it for that purpose. This may be effected by making on each floor a complete set of wards, offices, and nurses' rooms, which shall communicate with the rest of the building only through a single door, and shall have no means of communication with each other. A nurse to each set must then be provided, and the rest of the house may be utilised as an administrative department wherein all cooking for either set may be done and the communication between which and the isolated rooms should be as restricted as possible. But this is by no means so satisfactory an arrangement as that which may be provided on the most approved plans of infectious diseases hospitals of the present day, and though the expenditure necessary for its adoption may at the outset exceed that which has usually been considered sufficient for the erection of school infirmaries, yet it will be found in the end to have repaid the outlay in the better preservation of the health of the school. It may be asked if, with all the care that is professed for the treatment of two diseases at the same time in schools, sanitary zeal may not find itself outwitted by the having to meet the requirements necessary for the treatment in them of more than two infectious diseases at the same time; but this question may be set aside, not only on the grounds of improbability, but also because such a prospect is opposed to the results of general school experiences. Though more than two diseases of an infectious nature may make their appearance in English public schools during the same term, yet the rarity of such an occurrence makes it impossible to estimate the chances of their doing so, and when such is the case it would be unreasonable to suggest that any provision should be made which on the face of it appears not to be necessary. If it be thought requisite to be prepared for such a contingency, an additional room or small ward may be provided for the isolation of a single case of doubtful illness, while the sanatorium is in use for two diseases, until the very nature of the sickness be made manifest; but beyond such provision there is no reason to suppose that any other is requisite. The most efficient form of school infirmary may therefore be planned upon the lines of infectious diseases hospitals that have hitherto been found most useful. And it should not be forgotten that the school infirmary is not to be built for the mere housing of infectious sickness, but for the immediate isolation of it, so as to check its spread throughout a school. For this purpose the building should be at a considerable distance from the school, though not so far away as to necessitate a long and troublesome journey in the removal of a case to it from the school. The site should be such as to prevent any over-crowding of buildings, and therefore over-crowding of patients, and to provide for free and sufficient circulation of air about every part of the buildings. The sanatorium should, for a school of from 400 to 500 boys, be prepared to receive twenty patients, and should have south-easterly and north-westerly aspects, so as to avoid direct exposure to the east wind. The buildings may be best arranged in detached blocks of one storey high, and three in number, of which two should be used for the treatment of separate diseases, and the third as the chief administrative building of the establishment. For the economy of space, however, there can be no objection to this latter being two stories high. The administrative building should be built to insure three chief provisions, namely, suitable living accommodation for the permanent staff of the sanatorium, sleeping-rooms for the whole nursing staff that can be required at any one time, and an efficient kitchen and coal-house to serve the wants of the whole establishment. Of course, all those things which are essential in the erection of an ordinary dwelling-house are of equal importance in the building of this block; the differences must only be in internal arrangements. The approach from the administrative building to the ward buildings should be along an open footway protected from rain by a simple roofing supported on pillars, and that to the administrative building should be such as would not necessitate the passage of visitors in front of the ward windows. The distance between either block of ward buildings and the administrative building should not be less than 30 feet. One point of importance may be noted here in regard to the disposal of waste matters and ashes. There should never be in connection with an infectious-diseases hospital an ashpit of the ordinary size and kind, since this is capable of holding a cart-load of stuff liable to give off offensive emanations to the detriment of patients in its vicinity. A couple of tubs, each of which an able-bodied man could carry when full, should be the only receptacles provided for the purpose, and their contents should be removed even prior to their being full if the emanations from them become at all offensive. The most approved plan now in use in the building of ward-pavilions may be adopted with advantage in the building of school sanatoria, namely, the erection of the pavilions upon arches, so that the circulation of air around the building may be complete. But as it is inconvenient that the floors of the pavilion should be on a higher level than the ground surface it is found best to excavate the ground, and then to build the arches upon a foundation of concrete. The walls of the pavilions should be of brick or stone, and follow the same rules in respect to thickness as stated earlier in respect of school and classrooms. But since the treatment of infectious diseases only should be conducted within school sanatoria the inner surface of the ward walls should be made impervious and suitable for purposes of cleaning and disinfection, as by cement, tiles, or glazed bricks. Under no circumstances should they be papered or wainscotted. There should, moreover, be no projecting beams or ledges within the wards for infective material to find a resting-place; and in this connection it is most important to remember that all right angles in wall constructions are favourable to the harbouring of matter, and therefore of infectious material. It is possible to scrape with a penknife off the floor in the corner of even a well-cleaned room an amount of dirt which is often surprising, and in the wards of hospitals this may be made up of some of the best materials for the spread of infection. Therefore, converging walls, walls and ceiling, and walls and floor should be joined not in right angles but in the form of quadrants with the concave surfaces looking inwards. And since skirting-boards are unadvisable in infectious-diseases wards, the floors may be made to fit into the walls directly. The floors of the wards are best made of grooved and tongued boards, so that there may be no interspaces between them, and they should be polished. Besides the mere desirability of cleanliness or convenience, there is a much more important medico-sanitary question involved in this matter. The continual scrubbing and washing of unpolished ward-floors, when a high temperature is maintained in the ward, results in loading the ward-air unduly with moisture; and considering the susceptibility of fever-patients, especially among the young, to contract chills and colds, and the serious results which frequently follow on these, it is manifestly unwise to add the risks of them to those which already exist in the action of fever. A polished floor can, on the other hand, be quickly washed over and thoroughly dried, and is on that account to be commended. Each patient requires 144 square feet of floor-space, and 2000 cubic feet of air-space, and the bed of each should be separated from its fellow or an adjoining wall by a window which should exactly face one of the same dimensions in the opposite wall of the ward. It is likewise advisable that each bed have independent ventilation between it and the floor by means of an air-brick, which can be closed by a sliding door during inclemency of weather. All windows in the wards should be double-hung sliding-sashes for the purposes of ventilation, and should not be more than three feet above the floor, or reach within six inches of the ceiling. There should be one square foot of window-space for every seventy cubic feet of ward-space, but more is apt to lower unduly the temperature of the ward. Stoves open on two sides, and placed in the central line of the ward, will probably be found the best means for diffusing equable warmth and for maintaining a proper temperature, and they may be usefully employed for ventilation purposes. For if the chimney of each stove be surrounded by an open funnel, as it passes through the roof, the heat of the chimney will raise the temperature of the air in the funnel and insure its exit into the cooler atmosphere outside. Each ward or set of wards in any pavilion should be provided with a nurse's day-room, fitted with a small kitchener, so that the petty and immediate wants of patients for warm food may be supplied readily. But as it is unadvisable that a nurse on duty by day should also be employed at night, or that she should sleep in the same room that she inhabits by day, her place should be taken by a proper night-nurse while she takes her rest in the administrative building. The bath of each pavilion should be a moveable one, so that when necessary it can be wheeled to the bedside of a patient; but it should also be ready to serve the purposes of a fixed bath by placing it over a sink, and by supplying hot and cold water through taps projecting over its rim. All closets, and sinks, and lavatories should have their direct communication with the wards cut off by means of independent cross ventilation, and for this purpose may be conveniently placed together in a building abutting on the wards, but separated from them by an intervening well-ventilated lobby. The bedsteads should be of iron, and fitted with some form of wire mattress, so that they may be easily and sufficiently disinfected, and for this reason also the second mattresses should be thin, and of hair rather than of wool or other materials. No school sanatorium should be without its own disinfecting-house, for all disinfection which may be required ought to be done upon the premises of the establishment, and nowhere else; and it should be fitted with a thoroughly good disinfecting stove, together with other appliances which may be required for general disinfection purposes.

If the wards in either pavilion differ in size, one of them may not be required always, and may then serve sufficiently as a convalescent ward, and for the purposes of most school sanatoria it is at least doubtful if further provision of such a kind be necessary. But in very large schools a convalescent-room set apart from either pavilion may be found of great service in other matters than the one for which it would be usually required. For if at any time a case of doubtful illness arose when the sanatorium was otherwise in full use, it might be isolated at once in the convalescent-room for a time until its nature was exactly determined. Lastly, the sanatorium or infirmary should have a sufficient and wholesome supply of water, and should have very careful attention paid to every detail as well as to the general arrangements of its drainage.

WELL-ADMINISTERED SCHOOLS.

In connection with public elementary and day schools there exists a question of very considerable importance, affecting as it does not only the health of scholars, but also the rate of school attendance. Indeed, the latter is affected by the former both directly and indirectly. During wet weather children arrive at school usually fairly wrapped up about their shoulders in shawls or overcoats, but their boots and shoes are not unfrequently wet through. In these, unless other provision be made, they have to sit during the whole of their school hours. In the Exhibition will be found various means for the drying of boots and shoes; but it may be well to consider one or two other points at the same time. It is obviously unwise to allow children to be at work in school or class-rooms either barefooted or in stockings during the time that their boots are being dried, and they must therefore be wearing something on their feet. Nothing seems to be so good as slippers, for these might be kept at school without taking up much room, and would add to the comfort and happiness of the children until their return home in their dried boots. But, further, the use of slippers in elementary schools is one which may be always adopted to the advantage of both scholars and teachers, since the noise made by boots is so great in the junior classes as to disturb the discipline of the school. The adoption of slippers may be found to induce more children to attend school in wet weather; but there is still another class that have to be considered. Most school-attendance officers are greatly disturbed by heavy rain, for then some parents, pleading their inability through poverty to supply their children with good serviceable boots, fail to send their children to school. Even, however, if the boots are bad, children may yet go to school fairly safely if there be dry slippers for them on their arrival; but it is greatly to be lamented that for rainy weather custom has so greatly changed that the old-fashioned clogs are now no longer in use, and that even large holes in boots are preferred to the older form of foot-covering. Children in large towns have not so far to go to their schools that clogs need hurt or tire their feet, and at least they are more certain to keep their feet dry to and from school than are old boots and shoes.

From what has been said in the earlier part of this Handbook it may have been seen that much of the health of children in schools depends upon the care and administration of school and class-rooms. In this section of the subject, therefore, it will not perhaps be out of place to discuss or point out how much of this may be undertaken and planned so as to be made most suitable for the requirements of the scholars. The ventilation of class-rooms has already been referred to—especially the additional and constant ventilation—and there remains therefore but little else to say in regard to it; but it ought not to be forgotten that the direct result of imperfect ventilation is to produce a condition of air in school-rooms highly detrimental to the health of scholars. This is best shown by the amount of carbonic acid gas which is expired from the lungs and may be found in rooms, and by making comparison of it with that which is normal in ordinary air, and with the amount which is recognised as admissible in the air of ordinary dwelling-rooms. The object of ventilation is, of course, to reduce as much as possible the amount of carbonic acid gas and other effete matters, and to introduce in place of them that full amount of oxygen gas which is absolutely necessary to the life of all humanity. And in this connection the amount of cubic space allowed per head must be considered, for with a proper and sufficient air-space the means necessary for changing the air will be required in a less degree than if the amount of space be below the recognised suitable standards. In ordinary air the normal proportion of carbonic acid gas is from four to five parts in every 10,000 parts of air, and experiment has shown that when the amount of carbonic acid gas is increased to ten, rooms are felt to be "close." The respirations of persons in such an atmosphere are slightly increased, though they are not so much affected by the condition of the room as those who newly enter it from the outer air, and feel the difference more acutely. No one who has been into the gallery of a theatre in London can have failed to notice the utter oppressiveness of the atmosphere, heated by gas combustion and vitiated by the respirations of the mass of human beings throughout the whole building, nor can have overlooked the dulness and listlessness of those sitting in the gallery yawning and sighing—gasping for breath; or found it even tolerable after leaving the theatre for a short time, to return to the same atmosphere for more than a few minutes. Experiments made on such air showed (Hartley) carbonic acid gas in quantities rising as high as 32 parts in 10,000 of the air, and no one could for one moment suppose that such foul and headache-giving air, hardly to be borne in so-called pleasure-seeking, is the proper air for school-work to be conducted in. Yet M. F. Leblanc found in a children's school-room 47 parts, and in another 87 parts in 10,000 of the air. Dr. Roscoe, in our own country, found in a boys' school, where there were only 69 cubic feet of space per head, 31 parts, and in a girls' school, with 150 cubic feet per head, Pettenkofer found 72·3 parts in 10,000. If theatre experiences go for anything they may be usefully compared with what may occur in school-rooms for want of administrative care and forethought. But a consideration of the necessity for watchfulness in class-rooms shows yet other points relating to the health of scholars within them, in addition to those classed under the first division of this Handbook. If any air yet known, and to which all are liable to be subjected, has any injurious effect upon the human frame, vitiated air such as has just been described has most assuredly that effect; for the ills that follow upon air containing an excess of carbonic acid gas are feebleness of the circulation, with diminished action of the heart, less elimination of the gas from the lungs, and by its continuous retention in the blood obvious and serious alterations in bodily nutrition. Moreover this air is dangerous in that it is heated air, and that children leaving it suddenly to pass into outer colder air, weakened perhaps and tired from their school-work, are more than ever susceptible to the risks of sudden cold or chill. Those who have any experience of the ills of childhood know what such like mean, what care is required for their cure, what anxiety results from their neglect. Not on the grounds of sentiment, then, but rather on those of good sense is it desirable and right that school and class-rooms should be well and not indifferently ventilated. An almost equally important matter, though frivolous perhaps in the eyes of some, is the cleanliness of class-rooms. All schools, and especially day-schools, are noticeable for the large amount of dust that collects in them, and since dust is inspired into the lungs and has shown its mischievous effects upon them, it certainly ought not to be overlooked that its reduction to the smallest possible amount should be effected in all schools. And since it is very important that liability to ill-health should be avoided in all possible ways, it may be well to show how the health of children at schools—especially at public elementary schools—may be improved. It has been said that in addition to the constant ventilation of class-rooms during school-work there should be thorough and complete ventilation of them during the intervals of play, and this of course aids largely in rendering the air fresh and more pure. But the tendency to stooping, and therefore impaired chest movement, in some children, calls for additional physical aids to keep their lungs in healthy order and to permit the chest walls to assume their proper shape. In school intervals, therefore, scholars should be encouraged and made to go out into their yards or playgrounds to join in active exercise. English public schools are fitted with all the appliances for popular active games, and it cannot but be to the advantage of all schools to be similarly supplied. When, however, space and means do not allow of these being sufficiently provided, and when the weather is inclement, it is very advisable that regular drill for the exercise of limbs and body should be instituted. And for the exercise of the lungs, especially in infants' schools, there seems to be nothing which is so admirably suitable as the practice of class-singing. Again, as has previously been suggested, it cannot but be to the advantage of scholars immediately, and to teachers eventually, if on the entry of scholars to school, and at the beginning of each term, the sight of all be tested in some simple manner, as by "test-types." Such action may frequently check the current of eye-mischief, prevent its increase by school-work, and add largely to the happiness and prosperity of future life.

There remain but three divisions more of School Administration which it is possible to deal with, or even to refer to in the space of this Handbook, and they have been chosen from among the whole number of others, because of their very special bearing upon the matter of Healthy Schools, both directly as they affect the healthiness of schools, and indirectly as through scholars they indicate school health. And, indeed, the consideration of them may well interest all civilised people intimately or remotely associated with school life, for it cannot be doubted that the health of schools affects all school connections; affects the localities and communities in the midst of which they are placed; affects in family circles the happiness and the joys of life; affects the development of bodily and mental gifts; affects the future life as well as the present, and measures in part the responsibilities of every educated class. Perfection has not yet been reached, it is still in the far distance; and if it were not so, the Exhibition now held would be fruitless in its results; but as each year shows forth more clearly the need of advance, gradual and well-considered, and each step forward removes some mystery from the intricate and innumerable interlacements of cause with effect, surely there is encouragement enough inspired to urge onward improvements in the needs of life, and sufficient hopefulness in the human race to believe that in the handing on of knowledge through all time health and the good of life will yet be made more manifest. Therefore, however limited the notice of them must be in the circumstances and purposes of this pamphlet, their connections may yet be pointed out, and their usefulness considered.

In the administration of schools it is very doubtful if there be any questions more important than those of Feeding, School-hours, and the Controlling of Infectious Illnesses, and these are the matters that will be dealt with in consecutive order.

It need scarcely be said that food for schools should be of the simplest possible kind, but well-selected and well-cooked, so that its easy digestion may not be retarded. It is quite certain that indigestion is an evil which school-children are very liable to contract, and this is not unfrequently shown in touchiness of temper and stupidity over work. The dietetics of children require to be considered every bit as much as those of adults, and insufficiency or want of quality in food is certain to affect the health of schools. This is obvious, but it is none the less frequently overlooked. But though simplicity is so much to be aimed at in school-diet as opposed to luxury, yet the want of relish in it is a serious fault, which leads to the consumption of a less quantity of food than is requisite for health. The changes should be rung on the varieties of good foods; and these should be served hot, as a rule, and not in such a manner as to cause distaste or loathing. School-diet should never consist of articles of second-rate quality. The kinds of food should at least include vegetables every day—potatoes or greens, or both—meat, bread, and puddings, tea or coffee, milk, and good butter. The question must, however, be considered as to the allotment of such foods for each meal, and also as to the number of meals which may be necessary for scholars. In England it is often the rule that three meals in the day are the only periods at which food may be had, and these can be made sufficient for the needs of school-life only when carefully planned. Too frequently, however, meat is given but once in the day, which is not enough, and any additional meat-supply is put down in school-bills under the head of "extras." In adult life it often happens that the taking of meat only once in the day is sufficient, but it has yet to be proved that the active mental and bodily life of schools can be maintained on such an allowance, especially after ten years of age, when such life is very rapidly undergoing the processes of development, and needs the abundant supply of good material for its sustenance. As a general rule, boys at school need some meat at breakfast, whether it be only an egg or a rasher of bacon, in addition to their usual supply of bread, butter, and tea or coffee; hot roast or boiled meat, with vegetables and pudding, with a change occasionally to fish, for their dinner; and the usual "tea" of bread and butter and hot tea. But when this last meal is held at the usual hour of 6 to 6.30, the time that intervenes between it and breakfast the following morning is too long for young lads to be without food of some sort, especially when, as in most English public schools, "chapel" and a short work-hour is held before the morning meal. Either a biscuit or bread and cheese should be given for supper, or a cup of milk with a biscuit should be served out before the morning chapel. In French Lycées the official regulations prescribe the giving of meat twice in the day; and as supper is made one of the occasions on which it is given, the pupils in them are better able to stand the fast till breakfast. When, however, no meat is given at night, the interval ought to be broken in some measure, if only to prevent the keeping by schoolboys of private supplies. It may be found much better to introduce the use of milk in schools to a greater extent than is usually the case, for in summer especially, when milk is plentiful, there will be found in all schools boys who will take milk more readily than tea, and who will thereby be largely benefitted. The substitute may very well be made at either the morning or the evening meal, or at both. Without good cooking of food at schools, success in feeding will never be attained, for not only will there ensue positive distaste for the food, and in consequence a surreptitious feeding which, left in the irresponsible hands of boys, is made up of terrible and indescribable proportions—from sugar-candy to pork-pies—and also a loss of health, which cannot fail to reflect disagreeably upon school management. It is not every woman who calls herself a cook that speaks the truth; and if school-cooks are left to their own devices without supervision, the results of their operations are likely to be detrimental to the health of scholars and to be unappreciated by them. But for school food to be palatable and eaten readily, it must be well cooked, well carved, and really hot and of good kind, since, though boys after a morning of active exercise may eat greasy or dried-up foods from sheer hunger, arduous studies render their appetites less keen. And since it is so important that the cooking should be carefully performed, it may be said in passing that the kitchen-stoves at schools must be furnished with thoroughly good ovens and boilers, and that every attention should be paid to the temperatures to which they can be raised, the rapidity of their application to various cooking purposes, and to ventilation of the roasting ovens.

These foregoing considerations apply, of course, almost entirely to boarding-schools; but there is a much larger question of feeding at schools, yet in its infancy, and the further development of which may be fraught with the greatest possible advantage, not only to the scholars themselves, but to communities from which they come, and which may well be referred to here. It is the question of feeding in the public elementary schools of this country. The method of operation instituted in some few places where the experiment has been tried has been such as to rob this of the appearance of gratuitous or charitable aid, and has apparently succeeded in bettering the results of school-work and in increasing the rate of school-attendances. The meal supplied is only the mid-day meal or dinner, and consists of a basin of good hot and palatable soup or broth, and a piece of bread. It seems from the results of several trials that, speaking roughly, this meal can be managed in the country for a penny a head, and is naturally more easily accomplished without pecuniary loss if the children bring their piece of bread with them. Experiments in this matter have been made in several villages in Scotland, in Devonshire, and in Westmorland, and the results appear to be so far uniformly satisfactory. And when it is considered what is the kind of food that children walking long distances to school bring with them to sustain their mental powers for school-work, and their bodily powers for their walk to and from school, the benefit of one good meal in the middle of the day is incalculable, and certainly tends to better their health and strength than the piece of bread and butter, or "pasty," which but too frequently represents their dinner. Certainly no children whose only means of mid-day sustenance is represented by such a grotesque formula can be expected to face the conditions of severe and inclement weather, or brave the hardships of the winter months, for the advantages of education, when they live at considerable distances from their schools. Attendance in country districts during inclement weather has invariably been irregular, and the effect of the hot mid-day dinner for the sum of one penny, and in some instances of one halfpenny, per meal, has in this respect alone borne good fruit, for school attendance has been made regular, and has often been increased. The effect, however, upon the health of the children has been made even more strikingly manifest, not only in the lessening of their petty ailments, but also in the production of a buoyancy of spirits which but too frequently is stopped after dinner-time at school. In some places in Scotland the meal has been managed for one halfpenny per head per meal, but this small charge appears to have been made possible by gifts of potatoes and the like from farmers in the neighbourhood of the schools, and it seems to have been advocated, moreover, that the charge of one penny should cover the expense for all coming from one family, as otherwise the poor men with large families would find it hard to pay for each child. In the village referred to, as in Westmorland, the cost is about three farthings for each child, and each brings a piece of bread with it to the school. But whatever system is carried into effect, short of the absolute giving away gratuitously of food, it will probably be found to be one of the most popular institutions in all country schools, and will tend to strengthen and better the health of all the children, especially the weaker ones. And the appreciation of the system is not confined to the children alone, or even to their teachers, for the parents in villages in Scotland have emphatically recorded their approval of it, while from Westmorland comes the characteristic expression, with a splendid disregard of the grandest educational advantages, " T'best thing es ivver ye dud ! " And if the adoption of such a system of feeding has been found to be possible in the country, and to show good and successful results, it cannot but be to the advantage of school children in very large cities or manufacturing towns, reared, if reared they be, within the surroundings of squalor and dirt,—frequently the victims of vice and neglect,—or sometimes existing through the horrors of want, that they too should be brought within the workings of some such co-operative system, and be ensured means of maintaining and even obtaining bodily health and strength. That it would benefit the health of such children there can be no doubt, and the effect upon school-work would probably be made equally manifest; but it is not within the scope of this Handbook to discuss the details by which the application of the experiences from the country may be well adapted to the wants of town schools. The subject has only been introduced to show one more method by which schools in the country may be made more healthy, and to point out that the application of some similar method may be made productive of health in the children of city schools.

The distribution and the length of school-hours are matters of the very highest importance in relation to the health of scholars, and in the consideration of them it must not be overlooked that hours of study are frequently required to be taken for school-work from the intervening periods of recreation. It cannot be supposed that, if the time necessary for work in school is to be regulated with the utmost care, that indiscriminate working between school-hours can go on without detriment sooner or later to the health of children. Before the age of seven it is very doubtful if work ought to be competitive at all, or such as would require any additional preparation beyond that which could be made during regular school-hours. Between the ages of seven and ten, five hours' work a day is probably sufficient; between the ages of ten and fifteen, seven; and certainly no school-work should tend to largely increase these periods by extra work out of school. In French Lycées, under old regulations, eleven hours' work a day were required, inclusive of preparation-work; the time has now, however, been reduced generally to between seven and ten hours. In Germany, it appears that the amount of work required in the gymnasia necessitates so much time for preparation that there is scarcely any time left during the day for exercise. From what has been said previously, the system in England—a due and proper combination of work with play—tends to better the health of scholars, and to add to the usefulness of mental exercises; and certainly in this country it is customary to consider that, without active bodily training, mental elasticity and adaptation is not easy to obtain, and that no perfect health can be secured by the neglect of either mind or body. In boarding-schools it is a comparatively easy matter to regulate the hours that may be given to preparation-work, but it is otherwise in connection with day-schools, where home-study is necessitated. Indeed, it is almost certain that if parents and teachers do not enter into a solemn compact and understanding with each other, that they are likely enough to be found in the end pulling in opposite directions, instead of, as they should, with uniformity, and the inevitable result is that day-scholars residing at home are apt to suffer from doing too much preparation-work. It is doubtless very hard to suggest a remedy in such a matter, but it may generally be taken for granted that tasks and the times for their preparation which are found sufficient for boys residing at schools will be ample enough for home-study, if regulated on similar lines. It seems to be generally admitted now in English schools that work should be alternated with times for recreation. In the public elementary schools, it is usual to break the stretches of both morning and afternoon school-work by an interval of from ten to fifteen minutes, and school-hours do not in them often exceed five hours altogether. But in large boarding-schools, such as are understood in England as "Public Schools," the difficulty of distributing school-hours to the best advantage for the health and the work of scholars is often very great. Whether or not there be morning chapel and a short "repetition" hour before breakfast, the main school-work between breakfast and dinner should be preceded and followed by at least half-an-hour's recreation, and the period itself should be broken by an interval of fifteen minutes. It is sufficient, too, in all probability, to have only two hours' work in the afternoon, and none other again until after the evening meal, when the time left till bed-time may be employed in the preparation of work for the following day. But the question which is really very important is as to the time which should be taken for afternoon school-work. In winter it is certainly best to have no work after the mid-day dinner until four P.M., so that all the best and brightest hours of the afternoon may be spent in the open air in active exercise; but in the summer, no one who ever felt the joys of public school life would have yielded willingly to school-work one minute of those glorious evenings that were given up to cricket and bathing, or could even now be convinced that the robbery of those hours would not have lessened his powers of work, and rendered him listless and apathetic. Certainly no good preparation-work can be expected on summer nights, if the stifling heat of summer days is to be continuously borne in school for long periods. It follows, moreover, on these grounds that the plan of "keeping in" boys for breaches of school discipline is objectionable, and that it is infinitely better to require some loss of recreation-time in more healthy ways. In large public schools, where the drill-sergeant is an institution, there will probably be found no more efficacious mode of dealing with forgetfulness and petty turbulences than by calling in the aid of this functionary; and, if experience goes for anything, there is nothing in the whole course of school-life more horrible, detestable, or heartrending, than the having to give up engagements in school sports, social pursuits, or other school delights, to be for the period of one hour in the tender and merciful hands of the sergeant for the purposes of drill. He is the *bête noire* of unruly school-boys' half-holidays, and especially so when he parades his squad in full view of the, so far, virtuous brethren of the school; but in spite of the mental regrets of his recruits, he at least exercises a wholesome influence over them, and inflicts untold punishments for the refraction of school discipline without impairing their physical condition in any way, while at the same time lending "tone" to their bodily exercises. But, seriously, this is a very effectual way of punishing school-boys, and infinitely superior to the plan of keeping them within doors for omissions in school-work, for the simple reason that it keeps them in the open air while exercising their minds in the elaboration of regrets, and in the formation of excellent resolutions for future reform.

Finally, the very necessary question as to the controlling of contagious sickness as it arises in schools may be discussed in its bearings upon and relations with the maintenance of health in schools, and in its influence upon the schools themselves. In public elementary schools several things have to be taken into account, for not only must the question be considered how extension of disease may be prevented within school-premises, as by a daily inspection when occasion arises, but also how the influences, which may be in operation outside the school limits, may be best controlled, especially such as are involved in family circumstances, and that social intercourse which can perhaps be never wholly checked. For though the exclusion of infected children, and some of those which are healthy yet come from infected households, may be rigorously enforced, the school authorities cannot be certain that none of the healthy children will associate or mix with the families of their infected fellows, and so the fight against extension of a disease within the school may go on for almost an indefinite time, and seem to become a nearly hopeless struggle against a multiplying enemy. Schools must depend to a very large measure upon the activity and resolution of the sanitary authority of their district, and, if they expect helpful results from the action of this body, they must aid it to the best of their power with useful information to even a greater extent than that at present required by the regulations of the law. Referring to the conditions under which "Board" schools obtain their grants of money, the new Code of Regulations of the Education Department of this country states in Section 98 that "the managers must comply with any notice of the sanitary authority of the district in which the school is situated, requiring them for a specified time, with a view to preventing the spread of disease, either to close the school or to exclude any scholars from attendance, subject to an appeal to the Department if the managers consider the notice to be unreasonable." Obviously, if school authorities desire the best aid of the sanitary authority they must go far beyond these limited requirements, and refrain from hampering it through private jealousies by too hastily taking advantage of the latter part of the above clause. The Public Health (Ireland) Act, 1878, provides that any person sending a child to school within three months after suffering from any dangerous infectious disorder, or one who has resided in a house where any such case has existed within six weeks, without a certificate that the child is free from disease and infection, and that his or her clothing has been perfectly disinfected, is liable to a penalty. Similar regulations appear to be in force in Saxony, while in France, Belgium and New York, schools—public and private—seem to be placed under medical inspection. It is greatly to be regretted that in England more stringent regulations are not in force, but still the difficulties regarding public elementary schools may be fairly met by the combined action of the schools and the sanitary authorities. Speaking generally in respect of the most dangerous infectious diseases, such as scarlet-fever, small-pox, or diphtheria, the children living in the same house as the infected child should be kept away from school, and no child that has had scarlet-fever must be allowed to return to school before the end of eight weeks from the commencement of the illness. But beyond the 126th Section of the Public Health Act, 1875, there does not appear to be any other regulation in force in England which absolutely aids in the general limitation of infectious sickness. The section is, however, a comprehensive one, and enables anybody to lay an information against a person offending under it, without specially calling upon the sanitary authority of a district to take the initiative. It imposes a penalty upon persons who wilfully expose themselves or others in their charge while suffering from any dangerous infectious disorder, without proper precautions against spreading the said disorder in any public place or carriage, or who expose, lend, sell, or transmit, without previous disinfection, any clothing, bedding, or the like, which have been exposed to infection. This provision is, of course, sufficient for almost all purposes, but its success depends absolutely upon its enforcement, and it is worthy of note that it has been held to apply to clothing worn by persons who, while associating with the sick, expose themselves in a public place. The usefulness of the Acts now in force depends, however, entirely upon the manner in which they are carried out, and schools will find much protection if they will, immediately upon the appearance of infectious disorders within them, acquaint the sanitary authorities, so that a check may be at once put upon the spread of illness to the homes of other scholars. By such means, the closing of public elementary schools may be more frequently avoided than is the case when an attempt is made to hush matters up, and they are allowed to proceed to such an extent as it is then beyond the powers of prompt action to check. It is obviously very important, moreover, that if schools are not to be closed in consequence of the prevalence of infectious disorders, that some very plain and simple rules with regard to their management at such times should be carefully framed to meet the most obvious requirements that circumstances may then occasion. In the first place, whenever any infectious disorder, such as scarlet-fever, whooping-cough, measles, diphtheria, or small-pox, is prevalent in the district where a school is situated, or has even attacked any adult of a family that sends younger members of it to school, the schoolmaster or mistress should at once institute careful inquiries among the scholars as to the possibility of their contracting such disorder, and require the immediate withdrawal from the school of any child belonging to a family that is attacked, until its return may be considered safe. Such inquiries may also be well supplemented by a daily examination of all scholars for premonitory symptoms of illness, as of sore throat for scarlet-fever, and running at the eyes and nose for measles or influenza. But it may also be considered a good rule in all elementary schools, whenever there is a prevalence of some infectious disorder in the surrounding district, that no child should be allowed to remain at the school who shows any suspicious sign of ailing health. Schools may thus be saved from the dangers of infectious diseases spreading through them, and if, having obtained information of their prevalence among scholars, school authorities immediately acquaint the sanitary authority thereof, much further trouble and vexation may be averted. But when infectious illness has obtained a hold upon any school so that this is itself infected, and thereby made a centre for the distribution and spread of sickness throughout a community, as in a town, then it is in most cases necessary that the sanitary authority, for the preservation of the health of the many, must ask for the immediate closure and thorough disinfection of the school premises. It is plain, however, that the consequence of closing schools is to very seriously interfere with the business of popular education, and therefore it becomes all the more incumbent on school managers in their own interests to aid to the utmost in furnishing information, and to rely upon the skilled judgment of sanitary authorities for their protection, directly in their schools, and indirectly through the communities from which they draw their school materials. During infectious illness prevalence, it will be advantageous for elementary schools to fumigate the school-rooms every Saturday afternoon as a precautionary measure, and it is not less useful during the prevalence of diarrhœa sickness to disinfect all closets and privies, since these may be made, in the early stages of the sickness when overlooked, means for its future spread. The minor contagious affections of the skin, hair, and eyes, now so largely prevalent in elementary schools, can only be effectually controlled by frequent inspection, early detection, prompt isolation, and immediate treatment. It may not be always advisable, in the case of a large prevalence of mild sickness in towns, to close schools. For instance, during outbreaks of measles, when parents do not consider these dangerous to life, or even to health, from mistaken ideas concerning them, and in the belief that children are better for having them quickly once for all, and therefore allow their children to run about wherever they like, the spread of infection is much more liable to take place through the closing of schools than by keeping them open. For if infected children have more means for mixing with healthy children out of school than in school, the illness is likely enough to become more prevalent or even universal in the town, and therefore, in such a case, the closing of the school may do more harm than good. But when the school itself is manifestly the centre of infection chiefly in operation, then its immediate closure is an imperative duty, and should not be delayed, and is all the more likely to be effectual in checking the illness when the nature of this is so severe as to oblige the sick children to remain in bed and out of the way.

But, in connection with elementary schools in the country, there may be circumstances under which these may be the means of spreading contagious sickness over large areas. Especially is this the case when children attending them come from long distances and from scattered farms, cottages, and small hamlets, and therefore associate with each other perhaps only at school, for then the existence of a single unrecognised case of illness, or a want of prompt isolation, or of disinfection of the school, may cause the appearance of the sickness through a widely-extended district. It may be better that a country school so situated should be closed at once for a week on the occurrence of a single case of infectious sickness, while thorough disinfection of it is carried out, than to continue the school-work at the risk of its bringing itself to an untimely end by the sickening of the whole number of scholars.

From what has been said previously concerning the requirements of large boarding-schools in respect of sanatoria, it will be seen that these sufficiently indicate the means whereby the occurrence of contagious sickness in them may be suitably controlled, and little more need, therefore, be said about them ; but, at the same time, it never can be too earnestly impressed upon the authorities of such schools that they have very grave responsibilities attaching to them far beyond the limits of their school premises, and that the public, which is brought so closely into connection with them, have a right to demand protection for themselves and the varied interests in which they are most nearly concerned.

Though the limits of this Handbook have now been reached, it must not be supposed that the considerations and many dogmatic statements contained in it have been brought forward in any spirit of conclusiveness, or that the details of its subjects have been by any means exhausted even in matters of reference. The object of it has been to arouse interest in one of the health questions, which in these days forces itself upon the attention of many persons, and may be expected, with the growth of popular education, to attract the minds of most; and if such an interest has been occasioned, the effort will not have been in vain. But any interest which is excited will be worthless and unmeaning, possibly even mischievous and vexatious, if it have only an impulsive and spasmodic existence, ready to die at any moment like any other whim or fancy, or be born of some false sentiment that apes philanthropy and hides itself ignobly when detected behind the veil of masterly indifference. For any question which arises out of new and advancing knowledge cannot trace its finality of answer in rapidly succeeding bounds of thought, or in the dull wit of shallow reasoning, but rather in the persevering and steadily progressive exercise of inductive methods. And in respect of schools, it should not be forgotten that all the ills and evils that are thoughtlessly attributed to them are not wholly due to their defects, even if they do occasionally seem to aid in their development, for much has to be answered for in matters of hereditary taint and home education, of poverty and of wealth. Matters concerning school health are only some of those which enter into the whole question of hygiene for each individual, and they cannot be followed utterly regardless of other equally obvious rules of life without ultimate loss of health ; for, as hygiene is the expression of the art of preserving health, so no period of life can be passed through without the exercise of due care in every phase of it, nor can the intimate relation of one period with another, or the circumstances arising out of and affecting each, be ignored in the calculations of the whole course of healthy life. It follows, therefore, that the question of Healthy Schools cannot be dissociated from the considerations which affect all men in their observance of the laws of life, necessitated by the established principles of man's natural brotherhood, or created by the circumstances of civilised life.

HEALTH IN THE WORKSHOP.

BY

JAMES B. LAKEMAN, Esq.

H.M. SENIOR METROPOLITAN INSPECTOR OF FACTORIES, HOME OFFICE.

CONTENTS.

PART I.

PROGRESS OF FACTORY LEGISLATION FROM FIRST ACT IN 1802 TO LAST ACT IN 1883.

PAGE

Causes which led to each extension—Diseases and mortality consequent on employment in certain trades—Successful efforts to free children from ignorance and oppressive toil—Improvement in physical vigour and development . . 445

PART II.

ACCIDENTS, THEIR CAUSES AND EXTENT.

Where most frequent—Why, under more stringent regulations, not reduced in number nor severity—Dangerous machinery, how fenced—Cleaning machinery when in motion—Advice to operatives 465

PART III.

SANITATION.

Where most neglected — Effect of employment in noxious trades — Unconverted dwellings used as workshops prejudicial to health—Industries where females are employed in unsuitable work—Degeneracy and deformity of operatives—Gradual restoration to former condition of sturdiness —Deficiency of closet accommodation and appliances . . 487

PART IV.

VENTILATION.

Neglect of—General defect in structural arrangements of workshops—Temperature—Overcrowding—Artificial warming—Mechanical ventilation—Diffusion of air—Examples of modes of ordinary ventilation 531

HEALTH IN THE WORKSHOP.

PART I.

HISTORY OF FACTORY LEGISLATION, 1802 TO 1883

INASMUCH as a very large majority of the operatives of this Kingdom are said to be unacquainted with the history of factory legislation, and scarcely understand what the intention of law as applied to factories and workshops means, it has occurred to me, that it would not form an inappropriate preface to this handbook, were I to sketch in rapid survey the progressive stages of this great work, begun in the year 1802 and completed in 1883; and to show how, from small beginnings and in modest phrases, with gentle interference, the Act of Geo. III. was destined to lead men's minds to the application of similar restrictions, and how, from time to time, legislation on employment in our industrial centres ramified into trades other than were first contemplated, and how, by untiring energy on the part of philanthropists at first, and by the advocacy of men whose lives had been passed in the factory or at the bench in later times, the extension of legislative restriction became an absorbing question, pursuing its onward course, heedless of opposition from wheresoever proceeding; but proud in its strength, unchecked by circumstances of activity or depression, it has reached its culminating point by becoming the regulator of every industry, and the inquisitor into every evil connected with employment in the industries of this kingdom whether great or small.

Having extended its usefulness far beyond the conception of its first authors, and having been adapted to the many new features which fresh trades have opened up, from the extensive cotton mill and iron foundry, from the building of an ironclad to the humblest occupier of a little workshop in an alley of some back street, it has introduced restrictions, not, as in the earlier time, merely to grapple with the evils of prolonged employment, and deprivation of times for meals, or for the ensuring of ordinary cleanliness as opposed to dirt on the walls of a factory or workshop; but it has determined that the physical condition of the people shall be the basis upon which its future structure shall be built, that employment in vitiated atmospheres must be checked, that unhealthy occupations should be hedged round with proper restrictions, that overcrowding shall not be permitted, that life and limb shall be protected from accident, and, therefore, that all dangerous machinery shall be securely fenced, that children shall not be employed as of old, prematurely used up in body and mind, but that they shall work in manner suitable to their years, and permitted to add their tiny efforts to the industry of the country under conditions favourable to the development of a sound body, and with educational opportunities for their mental growth.

And, moreover, that a correct judgment may be formed of the effect of legislation on the health of our operatives, and to what extent the present generation is benefited thereby, it is necessary to lead the reader onwards through each stage of legislative extension, and to show how great was the wisdom displayed in selecting industries which at the time were ripe for admission into the fold of a paternal code, and how from disinclination to accept Government interference both on the part of the occupier and operative, persons engaged in those trades became admirers of, and champions for, further extension.

The Act for "the Preservation of the Health and Morals of Apprentices and Others, employed in Cotton and other Mills," passed in the reign of Geo. III., was the first Factory

Act introduced into England. It is singularly simple in construction, confining itself to the wants of apprentices in matters of clothing, cleanliness, ventilation and ample window openings, to the limitation of each day's work, to proper time for meals, but applicable to certain mills only; it prohibited night-work, and day-labour was not to exceed twelve hours of actual work of children of any age. It demanded that apartments for males and females should be kept distinct, that not more than two should sleep in one bed, that rooms should be washed with quicklime and water twice every year, and that care should be taken to admit fresh air; that apprentices should be provided with two complete suits of clothes, with suitable linen, stockings, hats and shoes, and one new complete suit was to be delivered to each apprentice once at least in every year. The observance of the Sabbath-day was not to be forgotten, inasmuch as instruction in the principles of the Christian religion was to be given for one hour a day at least on every Sunday by some duly appointed person, and before any apprentice shall have attained his 18th year, he was *to be carried* to the Parish Church to receive the Sacrament of the Lord's Supper.

It was also enacted that the condition of these factories should be reported to Justices at Quarter Sessions each year by two properly appointed visitors, and whenever infectious diseases prevailed, the visitors should require the masters to call in medical aid. Much is said now-a-days about "Paternal Government," but in 1803, this first attempt to improve the health and morals of operatives seems to evince such a generous desire to do good in the old-fashioned manner, that the words of the Act would almost suggest the necessity for its revival to-day; for there is no doubt whatever but that many a boy employed in a London printing office would think himself very lucky if similarly circumstanced.

It is singular to say that this Act of Geo. III., cap. 73, remains to-day unrepealed, but with all its good intentions it did not suffice to check the development of other evils which the large increase of factories produced, and such evils as were not contemplated by the framers of the Act of 1803, so that in 1833 the second Act was passed, having for its intention the regulation of the "Labour of Children and young Persons (not apprentices) in the Mills and Factories of the United Kingdom," for it assigned as a reason for further legislation that great numbers of "children and young persons were 'now' employed for a longer time than is desirable, and without due regard to their health or education." The tightening of the law is first perceived here, inasmuch as night-work was abolished for all under eighteen years of age, and those under eighteen could only be employed for twelve hours per day, whilst the employment of children under nine was prohibited, but those between the ages of eleven and thirteen were permitted to work for eight hours per day.

It also forbad the employment of a child in more than one mill in any one day, a practice which defeated the whole intention of the former Act, and so as to check the system, and to regulate the employment of children according to law, which for the want of properly appointed officers, was not done; a number of inspectors were set to work to prevent as quickly as possible the inhuman traffic in children's labour. The Act is silent upon any requirements for the protection of morals, for the teaching of religion, or for the clothing of apprentices; the more practical view of the real wants of the operatives was entertained, inasmuch as the cruelty of parents and employers arose as a mountain of iniquity to be levelled, before any moral or religious law could be valued. Children were taken from their beds in early morning, carried asleep on their fathers' backs, put into the mill to work, and so brought home at night to be replaced on the bed until 5 A.M. following. It was to prevent this that the half-time system began, though not as at present understood, but which laid the foundation for the full growth of that wise enactment, opposed as it was by the very persons who ought to have upheld it, but who preferred to see their children toil in over-taxed slavery, rather than that the blessings of education should be granted unto them. But so quickly did the system grow, nourished by men of indomitable courage, that in each succeeding age the half-time system was held to be the sheet-anchor of hope in securing to the whole juvenile population of the North nothing short of the full complement of that righteous Act which fed, and educated, and afforded proper time for relaxation and for meals to the whole of the children at work; and so that no master should frustrate the intention of the law, it was enacted that no child should be found on the premises for more than his nine hours, and parents, the chief offenders then, were liable to punishment if their children were in any way illegally employed with their knowledge, and the servants of mill-occupiers were also made responsible for any illegal act done by them; inspectors were required to report *on all their proceedings* to His Majesty's principal Secretary of State twice in every year.

The system of regular inspection was here instituted, and paid servants of the Crown were employed in the room of honorary gentlemen who held other public positions.

After ten years' experience, this Act was also found to be insufficient to meet the wants of factory operatives, and in 1844 another Act was passed, which, by its precise terms and stringent obligations, sufficed to control the ingenuities of masters and parents to prey upon the young, who, at this time, knew little else but hard toil; the factory leg (i.e. knees turned inward by standing too long in rooms heated to very high temperatures) and distorted spine were frequent objects of the effect of protracted labour, the race of factory workers were deteriorating in vigour, and were stunted in growth, so that the provisions of the Act of 1844 were urgently needed. Notice was now required to be given whenever a new factory was commenced, certifying surgeons were duly appointed to examine as to health and physical fitness of the young before it was lawful to employ them; cleanliness, as in former Acts, was to be confined to limewashing and painting the walls, ceilings and passages;

workers in wet flax spinning mills were to be protected from steam and hot water through which the flax was spun, and to which reference will be made in due course. Mill-gearing was not to be cleaned when in motion by any child or young person ; all dangerous gearing and machinery were to be securely fenced for the protection of children, young persons and females (not men), which provision is for the first time introduced into these Acts, showing that steam and water-power were being used more extensively, that inventions had effected changes in the construction of machines, which were run at a higher speed. Accidents from machinery were to be reported with a view to the investigation of the causes thereof, whether for the punishment of a wilful violation, or for the adoption of means for future safety : regularity in the observance of hours for work was to be secured by the keeping of factory time by some public clock beyond the control of the millowner. Registers of the names of all children and young persons were to be kept in the factory, the hours for work and times for meals were to be inserted on the authorised abstract, which was required to be exhibited in some prominent place where all workers could read them, and then, as a final clause to all those advanced precautions, the labour of children was settled in such a way as admitted of no doubt.

The day was now to be divided into two parts, one half for work, the other half for school, or one whole day to work, and the next to school ; and in order that meal-times should be regularly given, the day was portioned out and intervals assigned wherein to labour was deemed to be an offence. The saving of life and limb was also provided for by giving power to inspectors to give notice of dangerous machinery, which if not fenced at the time of expiration of said notice, a penalty would be incurred.

The Act extended its protection to all females, who, under it, were now treated as young persons, and it winds up its valuable provisions by so clearly stating what employment meant, that no subterfuge however subtle could wriggle out of the beautifully woven interstices of the official net.

These were the principal features of this largely developed Act, by which it held in check the inordinate desires of all parties concerned in textile manufacturing, to press unduly upon the labour of the young; but, as with former Acts, time brought fresh experiences to bear, men were advancing in all that pertained to manufacturing prosperity, fortunes were being rapidly made, and if by any chance the provisions of this Act as regards the labour of children could be contravened, many did not scruple to run the risk.

In 1846, the Print Works Act was passed, limiting the power of employing children and young persons and females. Reports were furnished showing that children were taken on as early as five years of age, but the majority began at eight or nine; their labour was very excessive, extending often to fourteen hours per day, in hot rooms varying in temperature from 65° to 110° Fahr. Many of them were said to faint under the influence of this tremendous heat, and in times of urgency it is stated that the only limit to employment was that which human strength could bear.

The extent of this trade, which printed on textile manufactures figures by means of blocks or cylinders moved by mechanical power, may be imagined, when, in 1849, 530 millions of yards of calico, &c., were printed, and in 1858 as many as 786 millions.

The Act was passed with certain modifications depending on the exigencies of the trade, and which allowed an extension to child-labour beyond that permitted by the textile Acts.

In 1848 an Act was passed reducing the hours of labour to ten per day, but it was decided that it was no offence to employ for any ten hours if counted consecutively from the time of commencing, so that by relays of workers there would be no limit to production. The many evasions of this section, as well as the heart-rending exhibitions of little children being forced to do more than a day's work at a stretch, and which the law as it stood could not well prevent, (the chances for detection being carefully watched) excited philanthropists to a resolve that a hard and fast line should be laid down, either before or after which employment would not be tolerated.

The fierce contention and strife over the "Ten Hours Bill," carried at first in its entirety, terminated in a compromise by the 13 & 14 Vict., c. 54, which enacted that no young person or female should be employed before six in the morning or after six in the evening, nor on Saturdays after two in the afternoon—a death-blow to the relay system; but let it be borne in mind, no mention is here made of further restriction in children's labour.

It was also decreed that there should be entered on the factory notices, the hours for work and times for meals, so that all workers could see for themselves what had been decided on.

In the gradual reduction of the hours from 12 to 10½ per day, we trace the cautious and tentative handiwork of another generation of men whose hearts were infused with a love for their fellow-creatures and who resolved that "now" the blow to evasion was to be struck, and that plain-sailing was to be the rule.

This was destined to be the foundation-stone upon which the fabric of future extensions were to be raised, a period to be dwelt upon by the workers of England with pride and thankfulness, for by it the way was opened for the consideration of higher advantages whereby the blessings of home could be more enjoyed.

Whenever the history of this period be read, men will reverence the self-denying incessant labours of those great minds whose power no opposition could check, and whose names will stand conspicuously forth as the harbingers of that freedom which England's sons were determined to secure. It was not to be wondered at that so decisive a victory should have invoked further enthusiasm, and that what was carried in 1850 should be supplemented by a Children's Act in 1853, forbidding their employment at times during which the labour of young persons and women was prohibited, so that the factory was actually to be closed for all manufacturing purposes at the same period of each day.

This was a great boon to children who were still deprived of what was intended for their good; but through an oversight not enacted, now, under no circumstances could their labour be extended beyond the fixed hour of six in the evening.

Up to this time, embracing a period of 50 years, legislation was confined to the welfare of children, young persons and females employed in textile factories; but in 1860, the Bleach and Dye Works Act was passed as a complement of the Print Works Act of 1846, which Act would have included the whole processes had not the opposition of the then Secretary of State been too strong for the advocates of the measures. The Act of 1802 was applied to cotton and woollen mills; the next Act, in 1833, restricted labour in cotton, woollen, worsted, silk, hemp, tow, flax and linen manufactories; the next Act of 1844 was an amendment appertaining to the same trades; the Act of 1850, styled "An Act to amend the Acts relating to Labour in Factories," was also an amendment on two previous Acts; it defined, *inter alia*, that night shall include the whole period between six of the clock in the evening and six of the clock in the morning, so that the relay system was again defeated and night-work was forbidden.

The Act of 1853 followed next in order, confining its intention to the labour of children, and in fact bringing them under the provisions of the previous Act.

In 1856 a short Act was passed defining more minutely what mill gearing was, and enacting that after notice from an inspector that machinery was dangerous, a penalty should attach to every case of disobedience to such notice.

In five years afterwards, so firmly had the blessings of protection been rooted in the industrial life of factory operatives in the trades aforecited, that persons interested in the cognate trade of lace manufacturing succeeded in the passing of "An Act to place the employment of Women, young Persons, Youths and Children in Lace Factories under the Regulations of the Factories Acts."

It is here to be noted that the first departure from, or rather the first admission into, the code on restricted manufactories is made of an outside trade. It was estimated that about 150,000 persons were engaged in lace manufacturing, of whom between 8000 to 10,000 were children and young persons. This act permitted youths between the ages of sixteen and eighteen to work between 4 A.M. and 10 P.M., but not for more than nine hours between those periods; in other modes of employment, the regulations of former Acts applied.

The desire to adapt the law to the requirements of trade, forms a striking feature of Factory legislation from first to last, and it is this very great adaptability which has so secured for the whole series of extensions such success in administration even up to the present day. Evils were known to exist—no possible argument could refute that fact; evidences for good were abundantly produced, and for fifty years the movement was stamped with a wholesome progression, and onwards it sped, seeking fresh places wherein dark spots were to be revealed, and where children uncared for were toiling in misery and wretchedness.

The spirit of inquiry was again roused, the old leaven of courage to remove oppression had not lost its power. A "Children's Employment Commission" was appointed in 1862, not to inquire into the workings of the Acts hereinbefore mentioned, but to take evidence upon the conditions of child labour in trades very different to the textile. The result of those inquiries disclosed very painful cases respecting the moral and physical condition of children engaged in the manufacture of earthenware, lucifer matches, percussion caps, cartridges, paper-staining, fustian cutting; and which enabled Parliament in 1864 to pass a new Act, not an amended Act, embracing quite a new field of enterprise, and destined, like its predecessor, to achieve a marvellous success in regenerating thousands of our semi-civilised workers in the Pottery districts. "Health in the Workshop" may be said to have had its birth at this period, for the Act recited for the first time—" Whereas it is expedient for the effectual cleansing and ventilation of the factories in which are carried on the manufactures and employments specified in the first schedule hereto, and for the regulation of the labour of the children, young persons, and women employed therein," &c.

This is the first time that those words are introduced side by side, inferring that although no machinery need be used for the purposes of manufacturing, yet something was to be done to cleanse and ventilate effectually. The 4th section of the Act says, " Every Factory to which this Act applies shall be kept in a cleanly state, and shall be ventilated in such a manner as to render harmless, so far as is practicable, any gases, dust, or other impurities generated in the process of manufacture that may be *injurious to health* ;" in addition to this, special rules were to be drawn up and adopted so as to protect the occupier from the consequences of any wilful disobedience to the law by any servant, intending that fair play should be shown to the master, upon whom heavy restrictions were to be placed ; and if, during his absence, or in case a foreman neglected to do what he was ordered to, then the servant or agent, pursuant to the rules so adopted, should be held to be the offender.

Protection to health was the principal feature of this Act ; for, in the manufacture of lucifer matches, no child, young person, or woman, was allowed to take meals in any part of the factory where any manufacturing process is usually carried on ; in the fustian-cutting trade no child should be allowed to commence work until the attainment of eleven years, and in the manufacture of earthenware, the restriction as to meals is similar to that referring to lucifer-match making.

The necessity for legislation in these industries may with advantage be briefly given : in earthenware districts, gross ignorance prevailed amongst the young. Out of a population of 70,000, only 2 per cent. attended school. In a population of 80,000, the percentage at school was 6·7; nearly all the scholars were under nine years old, and only 3 per cent. were over twelve.

The ages when children were taken on to work varied from five to nine, and very few were found who began work so late as ten years of age; amongst the reasons assigned why this very early age for employment obtained was, that mothers were the widows of potters who died young, or fathers were incapacitated through continued drunken habits. It was stated by medical evidence given before the Commissioners that the injuries to the constitutions of boys in their employment were very great, which, when young, were not fully shown; but as soon as these boys became journeymen the serious effects of work in the shops and stoves became palpable.

In the dipping process, the most injurious of all, paralysis, colic, or an early crippling of limbs were frequent, owing to the poisonous nature of "glaze," containing much lead in the dipping liquid; but as arsenic had been almost discontinued at this time, a less amount of suffering was apparent.

In the printing, painting, gilding, and burnishing departments, girls were subject to illness from inhalation of dust, and from sitting all day in close, ill-ventilated rooms; their occupations were for the most part refined and agreeable, and not necessarily injurious to health. The subjoined statement (see also Part III.) may serve to show to what extent the trade was an unhealthy one, previous to the enforcement of this Act.

The manager of a pottery in Scotland stated before the Commissioners that, during a period of fifteen years he took records of deaths and causes thereof, so as to show the extent of injury to health to which potters were subject; in seventeen instances of men working in the various processes, the ages at time of death lay between fifty and twenty, most of them being between twenty and thirty; eight causes of death were due to lung disease, three to asthma, three to consumption, two to cold and fever, one to debility; and further, as regards the ailments of the young who were employed in the various processes, the records of the North Staffordshire Infirmary for years 1854 to 1862 show that thirty-four cases were treated for complaints incident to the pottery manufacturing, such as hip-joint disease, necrosis, struma, curvature of spine, lead palsy, disease of knee joint, phthisis, and that the ages of the sufferers ranged from nine to twelve.

In the manufacturing of lucifer matches, there were found to be equally potent reasons why Factory law should intervene. It was stated by the Commissioners "that the manufacture is dangerous and unhealthy to the people employed in it, and also depends for its success upon the possession of chemical secrets," &c. "The manufacture of lucifer matches, though of not many years' growth, and but little known, is now carried on upon a very large scale in this and other European countries, principally France, Germany, and Sweden."

The labour is chiefly that of children, young persons and women, with a few men; the manufacture takes its rise from the discovery, in the year 1833, of a way of applying phosphorus to the match itself. Before that time many kinds of matches and other chemical means of producing light had been tried, but were all too costly, uncertain, or dangerous, to supersede the general use of flint, steel, and tinder.

It is important to notice these facts, as they account for the absence of any general knowledge of the nature of the employment and its effects upon the health of those engaged in it, the most marked of these effects being of a kind that have rarely been found to occur until after employment in the works for a considerable time, sometimes for years, and the less marked being more like common ailments, and thus easily escaping notice, or being assigned to other known or common causes. The report* further states that in 1845, medical attention was first turned, by a paper published by a surgeon in Vienna, to a most painful and loathsome disease found amongst the workpeople in match manufactories, now known as "necrosis of the jaw," or the "phosphorus disease," or the "flute," or the "compo."

---

* Report by Mr. J. E. White, 1862.

In process of time the disease became known in this country also, for in the same report details of the presence of the disease were given by Dr. Letheby in a lecture delivered by him at the London Hospital. From this period, says Dr. Letheby, i.e., after toothache, swelling of the gums and face, and decay of teeth, the swelling of the face grows larger; it extends to the neighbouring glands, the gums, spongy and red, recede from the teeth, and give exit to the openings thus formed to a most offensive smelling pus, one or more abscesses form over the jaw, they also break, and at every opening the same kind of unpleasant smelling matter is discharged.

It is then stated that the strength of the patient gives way, and after lingering for a longer time than one would think possible, he is at length worn out and dies.

In proof of the deadly workings of phosphorus, the evidence of a worker in a lucifer-match factory was taken, which is here given to show how valuable were those aids to knowledge that medical men were striving to bring before the public:—

"J. B. says he has worked for five years in one factory, and for fifteen years in another; has lost the whole of his lower jaw; it was bad for eight or nine years at first; it was very painful, no one can describe it if they don't know it; it's like everlasting pain; used to get hardly any sleep or ease of it; has been in several hospitals; his jaw was taken out at St. Bartholomew's; doctors said he ought to have meat, but he could not eat it. Afterwards he used to have his food cut up very small, and suck it. Cannot bite at all even now; doctor says there is a bit of new bone. One doctor would not take out his jaw, because, he said, there was a new one coming. Other doctors afterwards took it out, and the new one came along with it. The last time he took a piece of it out himself, and cured himself with cold water. Since then, has been in fair health, but not strong. Oh ! no, I never shall be again."

Without entering upon an explanation of the processes of this manufacture, in each of which danger to health was present, because, for want of space and proper appliances, the mixing of phosphorus, the dipping slab, the drying, cutting and storing rooms were under the same roof, and badly ventilated, I think sufficient evidence has been adduced to show how great need there was for legislative interference in this death-dealing trade as then carried on ; it will, however, be a pleasing change to note, under the head of sanitation, what great results have followed Government interference.

In 1867, only three years afterwards, another Act was passed, intituled "An Act for the Extension of the Factory Acts," founded upon the recommendations contained in the 2nd, 3rd, 4th and 5th reports of the "Children's Employment Commission," 1862. It extended the application of the Factory Act not only to a considerable number of trades quite distinct from any previously placed under restriction, but also included any premises where 50 or more persons were employed in any manufacturing process ; and in order that no injustice should be done to occupiers of premises who employed 50, an Act intituled "The Workshop Regulation Act, 1867," was passed in the same session, which subjected all places wherein less than 50 persons were employed to similar restrictions in regard to the labour of children, young persons and women, as were imposed on occupiers under the Factory Law.

Therefore the passing of these two Acts, extending the principles of the Factory Acts to almost every kind of labour not previously included, was another important epoch in the history of legislation concerning employment, which was said to have affected the well-being and condition of nearly one million and a half persons differing in habit, mode of life, and even in type, from any class heretofore included.

The humanising influences of the Law were now to be introduced to the Black Country, to the Midlands, and to all centres of industry, including London. Blast furnaces, copper mills, forges for the conversion of metal, foundries of iron, copper, brass, places wherein machinery was used in the manufacture of machinery, and of any other article of metal, were also to be included, whilst the manufacture of india-rubber, gutta-percha, paper making, glass manufacturing, tobacco cutting, cigar manufacturing, letter-press printing, book binding, were not to be overlooked, added to which were all premises wherein 50 or more persons were employed.

Sunday employment is forbidden in all places brought under the Act, except blast furnaces. No boy under the age of twelve, and no female could work in any glass factory where the process of melting or annealing glass is carried on. No child under eleven could work in the grinding departments of the metal trades. Meals were not to be taken in any part of a glass factory where grinding or polishing is done. Fans were to be erected for carrying off the dust generated in the grinding, glazing or polishing on wheels. The sanitary clauses of the Act of 1864 were re-enacted here, and over-crowding, mentioned for the first time, was forbidden.

Under this Act the hard and fast line of beginning and ending work, so warmly contended for in the Acts of 1850 and 1853, was relaxed to suit the customs or exigencies of certain trades depending on circumstances over which masters had not perfect control, and also in those handicrafts which were dependent on the seasons.

To this end a code of modifications was issued, granting concessions to certain classes of works, in order that restriction should not interfere too much with the requirements of trade. Each and every of those relaxations was hedged round with certain precautions, to prevent the possibility of extending the period for labour beyond the prescribed limit.

The Workshop Regulation Act then followed, gathering up all that was left by the Factory Act, whether great or small, and which defined employment to mean "occupied in any handicraft, whether for wages or not, under a master or under a *parent*," and handicraft meant "any manual labour, implying gain in the making, or repairing, or altering, or adapting for sale, any article."

In 1870, an important Act was passed repealing the Print Work Act of 1846, and the Bleach and Dye Works Act of 1860, and which enacted that after the 1st January, 1872, the Act of 1867 shall apply to the above-named trades in all respects as if the word "Factory," had been defined to mean Print Works and Bleaching Works.

In 1871 an "Exemption Act" in favour of Sunday employment for Jews was passed, granting them the right to work on the Christian Sabbath-day for the same length of time that the Gentiles work on the Saturday. The Jewish workers were very grateful for this concession, inasmuch as the numbers employed in the manufacture of articles of clothing are very large, and by the Act, they would only be enabled to work during four days of the week.

In 1874 a new Textile Act was passed, intituled "An Act to make better provision for improving the Health of Women, young Persons, and Children, employed in Manufactures, and for the Education of such Children, and otherwise to amend the Factory Acts." The title brings one back to the first Act in 1802, which was called "An Act for the Preservation of the Health and Morals of the Apprentices, etc.," so that it would seem as if the interval of seventy-two years, with all the changes and legislative enactments made during that period, was to be brought before the mind's eye, and health and morals were again to form the basis for an extended Act.

This Act reduced the total of a week's work of 60 hours to 56½; it abolished the power to recover lost time, and removed an advantage granted to silk-spinners to employ children as young persons at an earlier age that was allowed in any other class of textile factories; it increased the time for meals and rest from one hour and a half to two hours per day, and shortened the time for continuous labour from five hours to four hours and a half. By it the Saturday half holiday began at 1 o'clock, or 1.30, instead of 2 o'clock; it also raised the age of children from 13 to 14 years before it could be lawful to employ them all day, unless such children of the age of thirteen could procure satisfactory proof of their educational progress.

Under this Act the factory and the school were brought closer together, and certain regulations were passed in the Elementary Education Act, tending to improve the means for the education of factory children.

Thus ended the last chapter on Factory legislation upon every trade not previously included under it or some local Act, but so conflicting did the numbers of unrepealed Acts appear, so incongruous in their application to the peculiarities of each trade, that a Royal Commission was appointed in 1875 to review the whole series of Acts for the purpose of codification. Exhaustive evidence was taken from all parts of the Kingdom; no trade or peculiarity thereof was omitted; technical and official witnesses were examined, and an elaborate report was issued which enabled Parliament to pass a consolidated Act, intituled "The Factory and Workshop Act, 1878," and which included the only industry that remained under local jurisdiction, viz., that of bread and biscuit baking.

Thus, under so far-reaching an Act, all that appertains to "Health in the Workshop" would seem to be included in its sanitary clauses, and every objectionable process in each department of our industrial life met by some special provision, but which cannot be said to be thoroughly effective for reasons to be hereafter assigned.

In 1879 attention was again called to the injurious effects of employment in white-lead works; reports of investigation into the causes of death of certain females whilst employed therein, revealed the presence of poisonous inhalations which showed clearly that, even under good arrangements, some of the processes were prejudicial to health, and, notwithstanding the many improvements introduced, the evils were not reduced to any appreciable extent owing to the want of cleanliness, and a disregard of ordinary means of precaution by the workers.

In 1880 a prohibitive order was issued forbidding certain things to be done in white-lead works.

It was at this time that inspection was thoroughly undertaken of all bakehouses by H.M. Inspectors, who were called upon by the Act of 1878 to administer the law as therein specified, but which had been previously left to the care of local authorities. In 1881 a report was issued revealing the condition in which many metropolitan bakehouses were found, and which laid bare a disclosure of facts so horrifying to the public as to call for the application of an immediate remedy.

Therefore in 1883, an amended Act, relating to white-lead works and bakehouses, was passed, by which stringent rules were required to be subscribed to by occupiers of white-lead works, who could henceforth prosecute their trade only upon certain conditions, approved and certified by an inspector to be in conformity with the Act.

As to bakehouses, it was forbidden to let, or suffer to be occupied as a bakehouse, any room or place unless three very important regulations were complied with; thus—

(*a*) No water-closet, earth-closet, privy or ashpit, shall be within, or communicate directly with, the bakehouse.

(*b*) Any cistern for supplying water to the bakehouse shall be separate and distinct from any cistern for supplying water to a water-closet.

(*c*) No drain or pipe for carrying off fæcal matter or sewage matter, shall have an opening within the bakehouse.

These three regulations were the outcome of revelations made in the report in 1881, such as no one in the Kingdom would have believed possible of existence in any civilised community.

The question which this preface would suggest is, "How do we stand at the present time in regard to sanitation and health in our factories and workshops?"

Are all its extended provisions so understood by masters, and are all their workshops so circumstanced as to ensure such a fair adherence to the sanitary law, that it can safely be said that sufficient has been done to grapple with every evil and thereby to ensure health?

We have, however, emerged from the days of gross darkness and semi-civilisation once found amongst our factory population, when the ability to read and write was as nothing compared to that of taking up a broken end of a cotton thread, or running out the woollen yarn from a "billy machine;" for, as before stated, there were those who saw that if operatives were left to themselves, they might have continued *de die in diem* as servants to the wealthy, obedient to their will.

It seems, when writing upon this subject, that, from long personal experience, one gets fired with the enthusiasm of Crusaders, looking forward to great gain in a great cause; and so it really has been, if justly reviewed, nothing short of a real struggle for freedom physically and intellectually.

To-day we can boast of a fair race of workers, who, not deformed as of old, but living under the protection of laws most wisely formed and judiciously administered, can become respectable units in our industrial life—a race fully capable of thinking and acting upon economic questions, and thereby building up for themselves a power destined to be exercised in influencing the National Will.

PART II.

ACCIDENTS, THEIR CAUSES AND EXTENT.

PRESERVATION of life or limb, to an operative, very often means the saving of a bread-winner to a home of little ones. And the losing of life or limb implies an increase to the burdens of public institutions, and a loss of productive power; therefore, economically as well as morally, the prevention of accidents in factories should be a matter of deep concern, and every opportunity for the application of fresh ideas to that end should be sedulously fostered.

Whatever may be said of the grandeur of our industries, their magnitude, and excellence of contrivances for doing that which is required, their very perfection of machinery, which as they say in the north, "can do everything but talk," a sad list of fatal accidents, mutilations, amputations and contusions is presented to the public in the annual reports of H.M. Chief Inspector.

In many industries labour is necessarily severe and exposed to risks, which no safeguard can prevent, and men become so familiar with the ever-present danger as not to foresee it; some having enjoyed an immunity for years, fall victims to momentary forgetfulness—the adjusting of a strap, or the tightening of a nut, or the regulating of a carrier wheel might cause an accident at places where the same work had been done hundreds of times before; one man will perform a certain work knowing what he is about to do and how to do it, another will enter upon it without the exercise of a moment's thought and suffer therefrom, and young persons and children, who, from ignorance of the consequences of contact with certain portions of a machine, or from an unacquaintance with its movements, are often injured to the extent of loss of a member. When one considers what a multiplicity of trades there are in which complex machinery is used, the modes of manufacturing, and the numbers, ages, and conditions of persons assembled day by day in our factories, the thought of accident would involuntarily arise, and a question would be suggested to one's self thus: Are all the accidents we read of in factories the result of employment under the most favourable circumstances, or could any number of these have been prevented? The reply to that question will form the subject for this part of the handbook.

Much care and anxiety have been bestowed hereon by H.M. Inspectors for many years past, and legislation has devised a means whereby every accident arising from machinery shall be made known and investigated as to cause and extent, but with all this care and anxiety and official intervention, the number of accidents does not materially decrease.

Up to the year 1871 it was required that every accident which happened in a factory should be reported, whether such accident happened from machinery or otherwise; but by the Act of 1871, 34 & 35 Vict. c. 104, s. 7, it was enacted that the only accidents to be reported were those that caused loss of life to any person employed in the factory, and any accident which caused bodily injury, and was produced by machinery, or by explosion, or escape of gas, or steam, or metal, and of such a nature as to prevent the person injured by it from returning to his work in the factory within forty-eight hours after the occurrence of said accident, and to which was added by the Act of 1878, injury caused through a vat, pan or other structure filled with hot liquid, or molten metal, or other substance, or by explosion.

It is evident that as far as law could effect a decrease in the number of accidents from the check it placed upon occupiers, it as good as said that no serious accident shall happen that can escape official investigation with a view either to enforce conformity to the Act as to fencing, or to suggest by reports to H.M. Chief Inspector, an extension of powers to machinery or parts thereof not hitherto recognised, and which, upon the introduction of a fresh industry, should be advisable.

Accidents may be classified into three divisions:—(*a*) Those which happen by coming in contact with mill-gearing when in motion for manufacturing purposes, which is strictly forbidden, and therefore wilful on an occupier's part, or contributory on a workman's part; (*b*) Those which are the result of contact with machinery other than gearing, and to which operatives are exposed; (*c*) Those that occur through carelessness or from some fault under the control of the worker.

Prior to the Act of 1867, the textile mills and the factories brought under the Act of 1864, viz., pottery, lucifer-match making, fustian cutting, paper staining, percussion-cap and cartridge manufacturing, were the only places under inspection, but when the numerous industries wherein children, young persons, and females were found at work amongst unfenced machinery, were included in the Act of 1867, it is not to be wondered at that the number of accidents should have been largely in excess of the returns made in former years.

There are few persons unconnected with the industrial centres of this kingdom who could form any idea of the magnitude of our metal trades in Staffordshire, Worcestershire, Wolverhampton and Birmingham districts which include iron manufacturing in its largest sense. Chain and anchor making, nails and locks, brass and tin plate, metallic bedsteads, buttons, hooks and eyes, pins, needles, steel pens, cut and wrought nails, screws, harness, spurs, bits, tin toys, rat traps, gridirons, hinges, *et omnia sui generis*, and where the blast furnaces, mills and forges can be seen at night belching forth their flames, reminding one of the "*chaos et phlegethon*" of mythology.

The census of 1861 gave the total of 73,330 persons who were employed in the metal trades of England and Wales, of whom 70,000 were children, young persons and women. In the Birmingham district in 1862, there were 3800 children, young persons, and women at work in mills and forges, and in the iron manufacturing there were 17,729 persons who came under the provisions of the Factory Act. In Sheffield and district there were 30,000 at work under 20 years of age, and 10,000 women were also employed in the various mills. This vast number was included amongst factory workers and placed under supervision by the Act of 1867; the majority of them could not read or write; they were working amidst thickly-packed and totally naked machinery; they seemed to see no danger, so familiar were they with the sights of whirling wheels and quickly revolving shafts, which the apathy or disinclination of masters permitted so to continue. To set this extensive series of industries in order, and to bring them all within the restrictions of the law relating to the secure fencing of machinery was no ordinary task.

The introduction of steam power to stampers and piercers added largely to the number of the maimed and bruised; boys and women were usually employed in the work which may be thus described: A piece of metal plate had to be impressed with a pattern or figure; it was placed on a bed underneath which lay the die; the stamper, which ran up and down a framework, was disengaged when raised to its proper height; it then fell upon the plate, which was at once impressed. So quickly was the process carried on that crushed fingers and broken arms were frequent; the weight of the stamper was raised from 20 and 30 lbs., to 110 and 150 lbs., which a child was said to manage easily when aided by mechanical power. In the cutting of steel pens one can scarcely see the pen or the piece to be stamped exchange places under the stamper; it is computed that in one day a quick female hand will cut 36,000 pens in ten hours, each cut requiring two movements of the arm to be made in every second, therefore in one day a female exerts her arm to the number of 72,000 times—an exertion quite consistent with the belief that a pinch under the stamper was a matter of certainty.

Many accidents were said to have been caused through the inattention of women to their dress, their loose sleeves and skirts came in contact with shafting and driving straps of lathes in screw factories, often inflicting severe injuries, whereas if properly fitting garments were worn, and the arms encircled with a close sleeve, many of those accidents would probably have been prevented.

In button factories, where the turning, boring, grinding and polishing are done by boys and women, many minor accidents have been prevented by fencing and setting up superior machinery, and when age, experience, and care on the worker's part, be brought to bear, in connection with such an improvement in machinery as will reduce their bodily fatigue, it is hoped that a large decrease may be expected.

To illustrate the dangers from unfenced machinery to which the young were exposed, a sample case is submitted, from the numbers quoted in the Report of Children's Employment Commission, 1862. A boy aged 16 stated, "Have put my shoulder out (compound dislocation), from being caught in the band while drilling bayonets; was putting the band on when a little lad who was drilling, the same as I was, loosed it, and it caught me and got me right up to the ceiling, and I fell to the floor; there was no one in the shop to stop the machinery, only the little lad; I have got caught in bands twice before, but was not so much hurt as this time; have seen a boy have his fingers cut off with a drilling machine, minding his work, but slipped and fell, and catched his hands in the cogs."

Amongst men accidents were numerous and severe, traceable to the slipping of tools when grinding or to the reprehensible practice of cleaning machinery when in motion; or, by being caught by straps and pulleys which were unfenced and running near to the ground, many were entangled and carried round the shafts, and were either killed or frightfully mangled. Again, to show how great were the risks run by the employment of children amongst machinery of the class described, it was shown that in Birmingham 4¾ per cent. of children at work were 7 to 8 years old, 11¼ per cent. 8 to 9, 24 per cent. 9 to 10, 37½ per cent. 10 to 11, 61 per cent. 11 to 12, 71½ per cent. 12 to 13; and as in all probability the same amount of child employment obtained in the Sheffield district, a table of accidents taken from the Infirmary there from Nov. 1862 to Nov. 1863 is subjoined:—

No.	Age.	How injured.
1	16	Caught in a drum.
2	10	Ditto.
3	12	Ditto.
4	15	Ditto.
5	10	Ditto.
6	12	Ditto.
7	15	Caught in cog-wheel.
8	12	Hot metal got into his boot.
9	14	Splash from hammer caught his foot.
10	13	Hot metal.
11	13	Ditto.
12	17	Ditto.
13	16	Ditto.
14	17	Hot wire.
15	8	Beam of iron fell upon him.
16	12	Boring an oven, which fell on him.
17	14	Piece of metal fell on his leg.
18	13	Head hit by a crane handle.
19	14	Rolling iron and fell down.
20	14	Grinding knives, point entered abdomen.
21	14	Breaking of grindstone.
22	8	Fell from scaffold.
23	12	From knife blade when grinding.
24	17	From piece of metal.
25	14	Foreign body in eye, not described.

In the grinding trade it is said there is scarcely a man who arrives to his 21st year, but has lost the top of a finger or two.

Such were the liabilities of workers from childhood to manhood in these times of inhuman labour before the Act of 1867 was applied, for although restrictions as to employment were known to have existed for years in other trades and from which many a lesson for good might have been learned, it was only by the direct application of restriction to them that freedom from accident was considered worthy of attention.

As a starting point for my subject I propose to give extracts of an elaborate tabulation of accidents by Alexander Redgrave, Esq., C.B., H.M. Chief Inspector of Factories, in his report for October 1866, the last issued before the extension Act of 1867, which, with Mr. Baker's return in October 1868, will form a fair basis for comparison with future years. Mr. Redgrave says: "As there is now such a variety of operations under inspection and within the beneficent influence of the Factory Act, it will be useful and interesting to ascertain the causes of accidents, the particular parts of the machinery which have been the most fruitful sources of accidents, and how much of the recent increase in the number of accidents reported is due to the greater number of works under inspection.

"The following is the number of accidents from machinery in my district in each half year since April 1861, the date when the limits of my present district were fixed—

"In the six months	ending	April 30, 1861	1575
"	"	Oct. 31, 1861	1415
"	"	April 30, 1862	1026
"	"	Oct. 31, 1862	900
"	"	April 30, 1863	892
"	"	Oct. 31, 1863	1126
"	"	April 30, 1864	1112
"	"	Oct. 31, 1864	1293
"	"	April 30, 1865	1221
"	"	Oct. 31, 1865	1689
"	"	April 30, 1866	1794
"	"	Oct. 31, 1866	1883

"The increase in the six months ended 31 October, 1865 was due to the improved condition of the cotton trade. Of the 1883 during the half-year (October 1866) it will be seen from the following Table, in which the accidents are classified according to the particular works in which they occurred, that very few occurred in the establishments under the Factory Act Extension Act, 1864; the great bulk, viz., 1788 occurred in textile factories. For obvious reasons I restrict my remarks to accidents from the machinery or apparatus of a factory.

	Adults.		Young Persons.		Children.		Total.		
	M.	F.	M.	F.	M.	F.	M.	F.	M.&F.
Cotton Factories . .	256	169	209	278	142	66	607	513	1120
Woollen Factories .	49	32	64	59	6	7	119	98	217
Worsted Factories .	25	24	23	31	10	7	58	62	120
Flax Factories . .	36	105	83	62	18	8	137	175	312
Silk Factories . . .	2	5	4	6	1	1	7	12	19
Bleaching, Dyeing and Finishing Works .	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
Lace Factories . .	1	..	3	..	..	..	..	..	4
Earthenware Works .	6	1	3	..	..	..	9	1	10
Lucifer Match Works	1	..	4	..	..	..	5	..	5
Percussion Cap Works	..	1	..	..	..	..	..	1	1
Paper Staining Works	2	..	..	..	..	1	2	1	3

"No accidents were reported to me from fustian cutting works or cartridge factories.

"The proportion of accidents to establishments in my districts has been about—

44 in 100 Cotton Factories.
12 in 100 Woollen Factories.
20 in 100 Worsted Factories.
74 in 100 Flax Factories.
10 in 100 Silk Factories."

The above are the works under the original Factory Acts. Of the works more recently brought under inspection, there have been 5 in every 100 bleaching, dyeing and finishing works; 1 in every 100 lace factories; 2 in every 100 earthenware works; 13 in every 100 paper-staining works; and upon the total of works in my district an average of 24 in every 100 works.

Or, if the number of accidents be compared with the number of persons employed, very similar results will be obtained. For instance, according to the Parliamentary return for 1860, the proportions of the persons employed in the different classes of factories were—

In	Cotton Factories,	60	per cent.
„	Woollen „	11	„
„	Worsted „	11	„
„	Flax „	11	„
„	Silk „	7	„

Now, the proportion of persons injured in these different classes of employment was—

In	Cotton Factories,	63	per cent.
„	Woollen „	12	„
„	Worsted „	7	„
„	Flax „	17	„
„	Silk „	1	„

It appears, therefore, that the relative proportion of accidents is largest in flax factories, and this is accounted for from there being a greater proportion of females, young persons, and children, i.e., the least heedful class of operatives, employed in flax factories than in either of the other classes of works. The machinery also is heavy, and there being very little weaving by power under inspection, nearly all the factories contain the more dangerous kinds of machinery.

Although it thus appears that there are more accidents in flax than in other mills, they are generally of a slighter character, and that the more severe accidents occur in cotton factories.

Of fatal accidents fifteen happened to men engaged upon work more or less dangerous, such as cleaning shafts while in motion, putting straps upon drums while in motion, going too near a shaft, &c.

Four children were caught between the fixed and traversing parts of self-acting machinery, which proved fatal, and seven from various machines.

The constant employment upon revolving machinery very soon deadens the sense of danger, and the whirring of wheels and jarring of straps causes little apprehension to the busy population of a mill. Little children of nine and ten years of age run about with the utmost unconcern, and the ample skirts of females are fearlessly worn, very frequently with persistent obstinacy, in opposition to the rules of the mill; so that there is really, considering all things, not so great a mass of injury as might have been expected, although I think there is room for much greater precaution.

Again, the general and indiscriminate use of the hoist causes serious accidents; three persons have been killed and forty-five persons severely injured from imperfect arrangements in the management of hoists.

There are a variety of contrivances for preventing the escape of the shuttle from the loom, and I am very glad to be able to report that the accidents from this cause generally involving partial or total loss of vision have decreased; but still, there have been twenty-eight of these accidents, eight of which caused injury to the eyes of the poor weavers.

There is another class of accidents which are very serious and difficult to prevent, viz., those caused to children by their being caught when working between a fixed and movable part of a self-acting mule, especially in cotton factories. Every mule ought to be fitted with a self-cleaning apparatus; very many have them, and there is a *pro rata* reduction of danger to the operatives in the mills in which they have been adopted.

In other mills the safety of the children depends upon the will and care of the "minder," who prefers that his little "scavenger" should risk his life while dodging in and out between the moving machinery to clean and dry down the frame, instead of stopping the machinery to enable the child to perform his work and to return from his dangerous situation in safety. It is true that any one permitting a child to work between the fixed and traversing parts of a self-acting mule whilst in motion, is liable to prosecution, and I have prosecuted some lately; but it is not easy to procure evidence to prove that the minder knew that his little scavenger was under the mule. There have been twenty-two accidents from this cause, four of them fatal and eleven very severe.

I have spoken of the indifference of some of the operatives to the liability to injury by which they are surrounded, and this is evident when I find that seventy persons were injured in consequence of their playing with machinery in motion, wantonly placing in jeopardy their lives and limbs in mere bravado.

But a large number of accidents are caused by the eagerness of the workpeople to get through their work expeditiously.

It must be remembered that it is of the highest importance to manufacturers that their machinery should be in motion, that is, producing yarn and goods; every minute's stoppage is not only a loss of power, but of production, and the workpeople are urged by the overlookers, who are " interested in the quantity of work turned off to keep the machinery in motion, and it is no less important to those of the operatives who are paid by the weight or piece, that the machines should be kept in motion; consequently, although it is strictly forbidden in many, nay, in most factories, that machinery should be cleaned whilst in motion, it is nevertheless the constant practice in most, if not in all, that the workpeople do unreproved, pick out waste, wipe rollers and wheels whilst their frames are running. From this cause alone, 906 accidents have occurred during the six months; 623 in cotton mills, 96 in woollen mills, 56 in worsted mills, 126 in flax, and 5 in silk factories."

Such evidence as this may, in regard to textile factories, be presented as applicable to-day; and the solution of the statistics would lead to the conclusion that, although the Factory Act did not forbid men to expose themselves to danger by meddling with gearing when in motion, they therefore did so at the risk of their lives; and contrariwise, although the Factory Act specially forbad the employment of children in that most deadly operation of sweeping under the traversing part of a self-acting mule when in motion, an infraction of the law thereon resulted in the loss of four young lives and the sustaining of eighteen injuries by others, and this by the wilful act of overlookers who ran the chance of conviction through the difficulty of proof; again, although it is strictly forbidden to permit any child or young person to clean mill-gearing when running, 5 fatal, and 696 other injuries were the fruit of disobedience, although in this large number must be included the cleaning of machinery, which was not forbidden.

Then as to hoists, it is expressly said, that they shall be securely fenced, if children and young persons are liable to pass them, or to be employed near them, and here, too, 3 fatal accidents happened, and 45 lesser ones. Is it not fair to ask whether, after twenty-two years' experience of the dangers of certain machinery, such accidents ought not to be heard of? but H.M. Chief Inspector touched the true key, than whom no one living knows better how, and says, "that a large number of accidents are caused by the eagerness of work-people to get through their work, and workers are urged on by *overlookers who are interested in the quantity turned off*," which means that as he is paid by weight of the cotton spun, his receipts are to be swollen at the expense of the lives and limbs of helpless children who are really afraid of him. As to the habit of picking waste off machines, or from between rollers, the practice might not proceed so much from desire, or habit, as from fear which induces habit, lest fault be attributed to the necessity for such work.

Those who know what the inside life of a cotton mill is, will scarcely deny that overlookers in departments, where the greatest number of accidents happen, are rather sharp.

No more interesting return could be prepared, than one showing each mill wherein serious accidents happen, and then to compare the character of the mill with the Inspector's reports ; the result would probably show that where the factory is held by an advanced and generous occupier who does all he can for each person employed by him, there would be found that the least number of accidents had happened, as well as an absence of those fatal and serious ones resulting from a violation of the law.

In a report upon accidents by Mr. Baker, he said " there would seem to be either a peculiarity in the machinery to produce accidents, or a negligence of those precautions against danger by which they might be averted, to which latter remark there would be no difficulty in subscribing. But further on Mr. Baker goes to the root of the matter, just as Mr. Redgrave did, and says, " I am led to lay more particular stress on this subject from the apathy there is among so many employers, either to safely fence their machinery, or to compensate the sufferers, an apathy which, it is easy to foresee, will lead to the infliction of heavy penalties or to civil actions against employers."

In Mr. Baker's return for the half year selected by Mr. Redgrave, there were 18 amputations of limbs, 263 losses of fingers, 1,382 contusions, 47 concussions of the brain, 350 incised wounds, 28 dislocations, 319 fractures, 80 injuries to eyes principally from shuttle flying, 742 lacerations, 290 from cotton machinery, 527 burns from smelting works foundries and chemical works, 29 sprains, 15 cases which ended in blindness, 60 were fatal, or about 1 in every 63 was killed.

Taking the total number of accidents, those caused by machinery and which were not, it appears that 3,471 could not then be taken account of, and which fully bears out Mr. Redgrave's remark as to accidents over which the law had then no control, and when the total number for the whole year be taken, it shows 5,090 caused by machinery, and 7,886 were such as were not within the cognizance of the law. The following Table will show what progress has been made in the reduction of the number of accidents from machinery for the last ten years.

	Total Number.	Young Persons.	Children.	Total.
1874	7253	2220	761	367
1875	6614	1231	319	317
1876	6384	2471	552	260
1877	6129	2238	503	311
1878	5582	1997	447	263
1879	5333	1789	314	306
1880	4188	2258	437	455
1881	7599	2520	389	409
1882	8501	2841	403	444
Oct., 1883	8996	2875	403	401

The centesimal proportion of accidents to the number of factories as quoted by Mr. Redgrave, in 1866, was 32 per cent., and if that proportion were followed in regard to the total number of factories in Great Britain, it would give 287,872 as the number of factories in which the 8,996 accidents happened during the year ended October 1883. But the total number does not approach to anything near so high a figure, and therefore, instead of the average being 32 per cent., it is possible that it would be found nearer to 40.

Could not the co-operation of millowners be enlisted with a view to the reduction of so large a list of killed and wounded, and should they not, even at the loss of a few moments' production, decree that certain rules should be adhered to, so that amputations and maimings of dexter hands, which give the largest contribution to the list, and which to a large extent might have been avoided if the practice or habit of picking out and meddling with rollers or parts of machines were forbidden, might be less frequent?

One of the best features of the Act of 1878, was the forbidding of children and young persons to clean machinery when in motion, and as it is well known that in every well-appointed factory, a loose pulley is attached to each machine, which by aid of the rigger will throw the driving strap on to it from the driving pulley, and thereby stop the machine, both being under the perfect control of the operative, it is surprising that workers prefer to run a risk of injury, rather than to use a means at their disposal without the chance of incurring danger.

To show what might be done in preventing accidents by coming in contact with gearing in motion, the eminent French firm of Dollfus Mieg et Cie. of Mullhouse, exhibited at South Kensington in 1876 a model of an apparatus for the prevention of accidents from machinery in manufactories.

These ingenious arrangements are highly useful as showing the value of loose pulleys on *shafting*, but the remark of the exhibitor is so much to be admired that it is quoted here for an example. "The exhibitor does not prejudge any system; what he asserts, and what he has never ceased to assert for ten years, is, that we are *not* doing that which is an imperative duty, if we neglect to use all our efforts to prevent the deaths and mutilations which seem, by an unfortunate kind of fatalism, to be regarded as an inevitable tribute paid to industry.

"The vigilance in factories and works requires to be redoubled, the inventors of means of preventing accidents should be rewarded, and when an accident occurs which might have been prevented by such inventions or discoveries, the manufacturer or the workman whose imprudence has caused the mischief should not deem himself as acquitted in the face of public opinion by the payment of a single indemnity or by any other legal satisfaction."

Some years ago, when many trades were carried on by the aid of machinery that were not subject to the provisions of the Factory Act, but only under the Workshop Act, which did not compel machinery to be fenced, a notable instance of the value of restriction may be given, to show that to-day such a circumstance could not well happen. A flour mill was visited wherein was found very dangerous machinery unfenced, the writer of this essay found a child at work feeding a grist mill from a hopper above the grindstones, around which gearing and shafting were revolving and presenting a sure and speedy death to any one who might get in contact therewith.

Expostulations were made, and promises were given that the child should not work there, but all at once the master said, "Can you stop the boy working there?" A negative reply having been given, he stubbornly stood upon his rights, and exclaimed that "Law was nothing to him;" regard for the child was evidently external to his being; what he required was young labour, and so he continued to run the machinery without fencing, and still kept the boy on.

In fourteen days after the date of visit, newspapers in that locality issued posters in largest type, announcing the horrible mutilation of a child in this very place; the victim was this very boy. The master in utmost terror sent for me, and, humble enough through fear, not humbled by contrition, he wished to do what I had suggested, but which I had not the power to enforce. This is an example of the olden times; what of the present age?

The Employers' Liability Act, coupled with judgments delivered in our Superior Courts, will eventually prove a safeguard to our operatives as to accidents. It is to be hoped that fencings will be the rule rather than the exception, and inasmuch as the insistance for guarding every dangerous part of a machine has been so sedulously prosecuted throughout the kingdom, one must foresee very favourable results.

An Association of Textile Manufacturers, impelled with the spirit of the time, issued a code of instructions which is worthy of imitation.

"For the safety of persons employed in these works the following bye-laws must be strictly observed:—

"1. A workman shall not use a machine or plant in which he knows there is a defect, if such use is likely to occasion personal injury.

"2. No person shall attempt to clean machinery when in motion.

"3. Safety-guards shall be properly fixed on every machine before it is set in motion, and such guards shall not be removed whilst it is at work.

"4. Driving straps shall not be put on or taken off by any one except the person specially appointed for that purpose.

"5. Boys or other young persons shall in no case be allowed to oil machinery, and no machine shall be oiled when working if there is danger in so doing.

"6. Hoists shall not be worked by any one but those appointed for that purpose.

"7. A workman shall see that any notice or information required by the Employers' Liability Act to be given to him is entered in a book kept for that purpose."

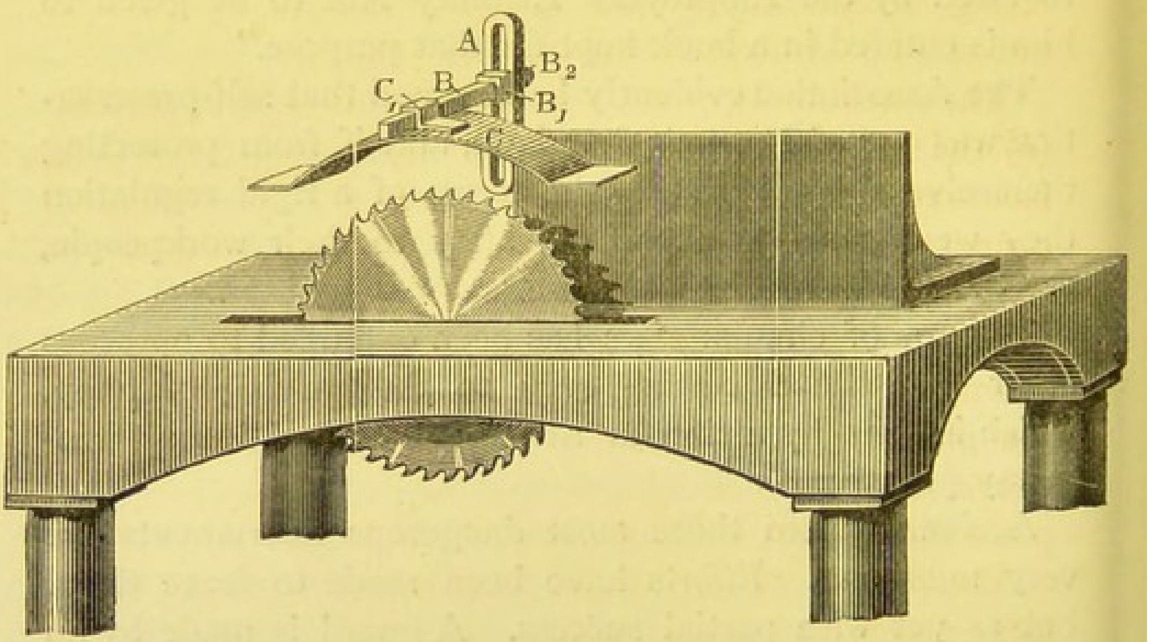
The Association evidently had learned that self-preservation was one of Nature's first laws, and if, from protecting themselves by adhering to the terms of a rigid regulation they were ensuring a greater safety to their workpeople, the effort is worthy of all praise.

The use of circular saws has been extended to purposes other than wood cutting, even to the carving of ivory, which is done by a circular saw about as large as a threepenny piece.

Accidents from those most dangerous instruments are very numerous. Efforts have been made to fence them, but as yet with partial success. A guard is made by an engineer's firm of which they speak favourably, and quote an instance of its utility.

It is well known that a large heap of sawdust soon accumulates, and persons are liable to stumble over it. A boy who carried the timber to the sawyer was thus engaged, when his foot stumbled in the sawdust, and he fell across the circular saw, which was revolving at 1,200 per minute ; had it not been for the guard he would probably have been cut in two, but he escaped unhurt.

The accompanying engraving illustrates a device for preventing accidents with circular saws, which require incessant watchfulness on the part of operatives, or serious results may, and frequently do, ensue. It is an invention of my own, and presented freely to the public in their interest, and in no way protected by patent right. From a lengthened experience of the many severe and fatal accidents which have been caused by circular saws, I resolved to strive to do something by way of devising a guard which might save a limb or probably a life. If we consider how many of these saws of all sizes are in use, and in what confined spaces many of them are set up whereat untrained labour is employed, at full speed, all day long, it is evident that great danger is ever present to a worker when the saw, running at 1,200 per minute, is unfenced.



A few of the causes of accident may be cited. The flying of timber from under the saw (fatal results are known to have arisen from this); the recoiling of timber, whereby workers are struck in the bowels (fatal accidents have been caused hereby); a knot or extraneous substance hidden in the wood has flown out and cut sawyers' heads open; falling across blade of saw; slipping in sawdust, and in recovering one's balance the worker finds himself maimed as to his arm or hand; and, lastly, one has only to visit these places, where many workers will testify to the dangers of their occupations, as evidenced by the loss of fingers, hands or arms.

From the engraving it will be seen that the guard consists of three pieces, namely:—(1) The mortise plate, A, secured by three bolts to the fence; (2) the radial arm, B, which is secured and adjusted vertically into the mortise plate, A, by means of the nut and collar B_1B_2; and (3) the covering plate, C, which is secured and adjusted laterally in the radial arm, B, in conformity with the adjustment of the saw fence, by means of the thumb-screw, C_1. Where several saws of various diameters are used in the same bench, it is advisable to have two or, perhaps, three covering plates, C, graduating in size to cover the whole series of saws. The apparatus is in its mode of fixing exceedingly simple, and immovable when fixed, and not at all obstructive to the sawyer.

The intention is, that:—(*a*) No one can fall on the saw; (*b*) the sawdust is prevented from flying into the sawyer's face and eyes, a frequent source of danger; (*c*) the sawyer cannot reach with his hand over the blade of the saw (arms have been cut off by the catching of smock, or shirt-sleeves in the teeth of saws); (*d*) the wood is prevented from "jumping" and striking the sawyer; and (*e*) the end of the plates of the guard being extended beyond the radius of the saw, and horizontal to the bench, men cannot easily place their hands close to teeth of saw.

The plying of shuttles in cotton mills has caused a very large number of serious accidents to eyes. Many persons have tried to invent an effective guard, but so swiftly does the shuttle travel, and so free must it be to run its course, that all attempts have more or less failed.

The attention of H.M. Chief Inspector of Factories has been largely directed to this subject, and it is to be hoped that some method has at last been devised to lessen these grievous misfortunes, which of necessity arise from the increased speed of the shuttle, which used to run from 90 to 112 per minute, but now from 170 to 200; formerly one woman tended to one loom, afterwards she was allowed to work two, but now a clever weaver will look after four; therefore her chances of accident are fourfold.

In self-acting mule-spinning, where children get killed or mutilated, a patent mule was made by a north country firm which had the one great advantage of being stopped at any stage on its journey in a moment, but it is not believed that so great an improvement in the manufacture of these machines is as yet general.

No greater instance of the value of the Act as to saving of persons from accident can be cited than in the trade of letterpress printing, where boys often came into contact with unfenced machinery, and who injured themselves from an unacquaintance with the movements of the presses at which they worked. So extraordinary has been the development of the various processes of the trade that one can seldom see a machine that had been in use ten years ago, that is to say those which are required for the ordinary printing of large paper.

Printing offices were once dark, underground, and dirty, machinery closely packed together and unfenced; but now concentric wheels will be seen generally well fenced, projections covered, fly-wheels to machines guarded, and other protections set up, such as would not have been dreamed of a few years ago; but to-day such care-taking is amongst the printer's daily considerations.

So in wet flax-spinning, a perfect guard has been patented for covering the transverse knife which runs across the wooden rollers to keep them fluted so as to grip the flax in its progress through the frame, and by this contrivance many accidents are averted; in scutching too, ponderous machines and low set gear have been duly fenced, whereby persons not fully alive to the dangers that beset them whilst employed at these machines are protected. If reference be made to paper mills, where most dangerous and complex machinery lay exposed, though not running at a speed equal to other machinery, or to the large brick and tile works whose masters never paid heed to the danger which their hands were exposed to, or to the larger works where machinery runs rapidly, such as blast furnaces, iron mills, machinery manufacturing, chemical works, sugar refineries, envelope and cardboard manufactories, in gutta percha and india-rubber works, evidences of the value of restrictive law can be seen in the fencings of parts which are said to be dangerous. Should a thought be bestowed on the grinding trades at Sheffield, where accidents assumed large proportions, arising from the carelessness of workers, especially from cleaning machinery when in motion, it is a good testimony to the value of the exertions made that fans have been set up for the workers' comfort, so that by the removal of dust and flying grit they might work without so much exposure to bodily injury.

In the manufacture of mineral water, when the trade first assumed a footing in our staple productions, the mode of manufacturing was crude and dangerous from the numbers of bottles that burst, and which inflicted deep gashes on the face and often destroyed the sight; no safeguards were then known for face or hands. As soon as restriction was imposed upon manufacturers, a fencing-mask was introduced, certainly not to be despised, but it was found to be cumbrous and ill-fitting, and afforded no protection to the hands, which held a wrapper bound round the bottle; still, they were bare and exposed to the danger of explosion.

At length improvement in manufacturing commenced, and with them an improved method of bottling, whereby, by use of a shield, the bottle was enveloped and held; but as yet the right hand was not protected altogether. At last, very elegant machines were produced for making and bottling, affording freedom from accident, a rapidity for filling, absolute cleanliness and corresponding cheapness, and last of all the filling is now done by the aid of motive power, whereat no hand need approach. If a list of all the works in the kingdom were given, and the peculiarities of all the machinery to suit each kind of production could be explained, what a monument of labour would be inferred as necessary to keep them all going! Therefore, these causes for accident should be duly weighed, and an importance attached to every one that happened through a direct violation of regulations.

If such examples of the fencing of machinery in trades of so different a character can be instanced to show what an amount of thought must have been expended by masters in their desire to satisfy the requirements of the law as to safety in employment, a lesson ought certainly to be learned by our operatives that whenever at work near to any motive power or rapidly moving machinery, presence of mind should not be abandoned for an instant, and at every turn the thought should suggest itself that a false step or an imprudent act might be disastrous, notwithstanding the fact that machines and gearing may be fairly well protected.

One must hope, from all the agencies at work for good, from the growing intelligence of operatives, from the extended education of masters in all that pertains to efficient fencing, that the aggregate of accidents will be largely reduced, especially in those cases to which heedlessness or recklessness can be attributed.

PART III.

SANITATION ; WHERE NEEDED AND HOW APPLIED.

SANITATION.

It will be admitted that no portion of the Factory Code deserves higher consideration than the clause which enforces sanitation upon occupiers of factories and workshops.

It is commended for the extensiveness of its application and for the absoluteness of its demands. To define it in reference to the several industries of this kingdom would seem to imply a special adaptation of the enactment to every trade so as to remove all causes of hindrance to the ensuring of perfect health to workers.

What is necessary for a cotton mill would be inapplicable to a leather factory ; and what is needed for a flax mill would not apply to a shirt manufacturing workshop. But the handsome silk mill, surrounded with pleasure grounds and flower-beds, wherein cleanliness, light, and air abound, is subject to the same sanitary clause as a lucifer-match factory, or the underground machine-room of a letterpress printer. The tailor's workshop is inspected under that one regulation as is the mill wherein cloth is woven ; both must be regulated by an absolute law which says, "Thou shalt be clean!"

It is this very absoluteness, applied to so great a variety of trades, each having its own peculiarity in manufacturing and exhibiting so many varieties in habits and dispositions of masters and workers in regard to it, which has contributed to the progress made in a general desire to acknowledge the advantages which an adherence to sanitary law has produced.

Evidences are not wanting to show us that the welfare of our people in all that concerns their health, whether as to food, or to dwellings, or to places wherein they work, is the paramount question of the day. Agencies are set in motion by legislative means, including factory and educational officials, who are striving to accomplish the one great object of making the operatives of the country happier through improved ideas of cleanliness and education, and to the fitting them for higher social enjoyments.

That health in the workshop is of equal importance to health in the home will be accepted, seeing how large a portion of the lives of operatives is passed therein, and where habits are formed which cannot fail to influence workers according to the conditions under which they labour.

If, then, the means necessary to be applied for the good of the people in their homes be so far attractive as to cause occupiers of workshops to reflect on this most important and complex question, so closely interwoven with their own interests, a salutary example will have been set to all who would fain see health in the workshop an accomplished fact; for in proportion to the growth of people's desires to dwell in cleanly homes, so would their aim be to work in healthy workshops, and in pronouncing for improvement where most needed, the conjunction of a similar conviction as to workshops cannot but doubly act as an incentive to a desire for both.

No doubt an impetus will be given to a deeper consideration of the question from the efforts now being made for improving the dwellings of artisans, inasmuch as many of the evils of insanitation in workshops might be mitigated by workers, who from habit contribute to the neglected state in which many of them are kept.

So important is this subject that no reference will be make in this chapter to the opinions of scientific men or specialists; a statement of plain facts will be presented showing what the sanitary condition of factories was prior to 1864, and what means have been adopted towards improvement, so that readers may be convinced that in this branch also of factory history success has followed its course, that gradual openings into the thick films of dirt and impurity in workshops, and the removal of gases, dust, and vapours in factories have been effected, that objections have been overcome, scruples laid aside, prejudices soothed, obstinacy tamed, and fair acquiescence obtained.

The securing of "Health in the Workshop" may be said to have begun in 1864, when the first real sanitary clause was enacted, referring only to the six trades brought under restriction, and which in no way interfered with the sanitary condition or otherwise of textile factories, which were required to be limewashed every fourteen months, and not subject to any other special sanitary provision except that relating to wet flax-spinning. Therefore the work of removing all that interfered with the health of workers in factories begun with trades under the Act of 1864 before it did with those subject to restriction in 1802–1844.

It is required by Act of 1864, and finally extended by Act of 1878, that every factory or workshop shall be kept in a cleanly state, and free from effluvia arising from any drain, privy or other nuisance, and shall not be so overcrowded whilst work is carried on therein as to be injurious to the health of workers, and shall be ventilated in such a manner as to render harmless, so far as is practicable, all the gases, vapours, dust, or other impurities generated in the course of the manufacturing process or handicraft carried on therein that may be injurious to health.

This extensive enactment applies now to every factory and workshop in the kingdom, and if it were possible to say that each part thereof, as far as it applies to every industry, was effective, it would be conclusive evidence that health in the workshop was secured.

It is proposed to deal with trades under each Act in order of time, so that a fair exposition may be presented of what has been done in factories considered to be injurious to health, then to inquire into the state of factories wherein the manufacturing process is not injurious to health, and lastly, to take up some classes of workshops, pointing out wherein sanitation is generally defective.

By the first Act of 1802, lime-washing and window-openings to ensure fresh-air supply were all that was required in textile mills. In the Act of 1833 lime-washing only was required, and singular to say, no mention is made of window-openings nor ventilation. In the Act of 1844 lime-washing only is re-enacted, and although this Act was more extensive in its general dealings with all kinds of textile factories, it only attached a penalty to the neglect of lime-washing, showing that sanitation was a science not much known then and less practised.

In 1864 six unhealthy trades were brought under inspection, and then sanitation was enforced under the powers of that Act by a clause which has been re-enacted. Rules, drawn up by masters, were made valid for the enforcement of cleanliness and ventilation by servants.

In the Act of 1867 overcrowding is first mentioned in a section separate from the re-enacted sanitary clause, and exemption from lime-washing was allowed to certain trades. But under the Workshop Regulation Act of 1867, sanitary matters were entirely unregulated, although this Act took notice of the very places where insanitation would most likely abound; and as the enforcement of that Act was relegated to local authority, it was no doubt designedly omitted, seeing that the introduction of so large a measure of restriction was to be at first but nominally enforced. In 1871 the Factory and Workshop Act was passed, bringing under one code all that was enacted in Acts 1833 to 1871, and then it became the duty of inspectors of factories, and not that of the local authority, to assume jurisdiction over workshops in like manner as in factories.

Therefore it was at this time that the wide sphere of usefulness was opened wherein all that was in violation of sanitary law in every place of industry in Great Britain was entrusted to H.M.'s Inspectors of Factories to remove, and inasmuch as many occupations carried on in workshops came into direct competition with like ones in factories, it was incumbent on the executive to use every effort that in administration care should be taken to ensure an impartiality in restriction and a uniformity in procedure, that undue labour should be moderated, that workshops and factories should be kept healthy, and that the education of the young should be enforced.

Textile factories. Cotton.

Years ago a cotton mill was a very different place as to structure, dimensions, appliances, and mode of manufacturing, to what it is to-day. Water was the moving power, machinery was clumsy by comparison, speed was slow, the thing produced was simple, and would be called to-day rude in texture and appearance; labour was irregular, depending upon the supply of motive power, and therefore at times operatives worked for exceedingly long hours, to compensate for loss in times of drought. The mill was built under a hillside, and such considerations as were given to sanitation consisted only of the ingress of free air which the Lancashire heights afforded. But when machinery was improved, and speed quickened, when enterprise incited men to greater activity, mills grew in proportion, and multiplied in numbers. Even then there was no great impurity, nor was the atmosphere clouded with floating fibrous matter; but as soon as steam factories were built, and no proper means provided for the accommodation of workers, and when machinery was put on to quicker speed, then it was that the natural proneness of man to aggrandize himself at the cost of human health and happiness was developed.

It was during this period (1802–1833) that degeneracy marked the effects of protracted labour—the primitive race of sturdy cotton hands disappeared before a generation of weak and deformed people. Continuous labour by day, and also by night, in hot, close, and ill-ventilated factories, and their dwelling in homes still more impure, so far affected the operatives, that they seemed to have become a distinct race, as to physique and condition. It was to counteract this downward tendency that the Act of 1833 was passed. High temperatures, want of ventilation, no escape for dust or atomic fibrous matter, no proper closet arrangements, were the chief ills existing; the height of floors did not exceed 8 to 10 feet, although the cubic space was ample. In the carding and blowing rooms there were no appliances for carrying off dust and impurities, but in a cloudy mist the workers had to remain.

It is said that poisonous gas from cesspools permeated the factories, that disease contracted in the mills was taken home, and by the continued breathing in of a tainted atmosphere, the countenances became pallid and limbs distorted.

No sooner had the consequences of greater restriction been felt than larger mills were raised, more improved machinery set up, speed again quickened, and production increased; the number of spindles to each mule was also increased from 30 to 200, and in 1833 to 350, until at the present time they number 900 to 1000 each. The health and vigour of the operatives were gradually returning, and at the time of the passing of the Act in 1848, it is asserted that the cotton operatives had steadily improved, and so continued until they were equal in growth and strength to any other of the working classes wherever found.

Now, if we look at the cotton mill to-day, we find self-acting machinery, the carding machine covered in, the willowing machine also covered in, fans used for blowing off the dust which the willowing scattered over the floor and throughout the room. The process of stripping is self-acting, under covered carders, a cubic space of at least 2000 feet is given to each person, because machinery requires more room and less workers; heat is reduced to normal temperature, the hours for labour are reduced to 56½ per week, the time for meals extended to two hours per day, certificates of fitness upon a surgeon's examination as to bodily strength must be obtained previous to employment, the half-time age is extended to 14 years, and schooling is efficiently carried out; therefore to-day there is much cause for congratulation in being able to look back upon 80 years and to view at each extension of the law what gradual and consistent and strengthened advances have been made; and what is more, how generations of masters have not been slow, in their progress in knowledge and culture, to embrace every opportunity of seconding the intent of legislative enactments. The magnitude of this trade may be imagined from the following return :—

In 1875, 2,484 mills were running, having 38,218,758, spinning spindles, 440,676 power looms, employing 450,087 persons, and spinning per year 1,223,000,000 lbs.

(The ventilation of weaving sheds will be referred to under the head of Ventilation.)

Worsted and woollen.

Then as to worsted and woollen mills, progression equally marked has steadily followed in the wake of cotton, and to-day these trades may be safely said to be healthy in each department. The old wretched places of 1833, small and dark, have disappeared, magnificent structures have been reared, machinery of the most approved patterns has been set up, child-labour is lightened by the introduction of compound machinery, the temperature is normal, and the sanitation good. Total employed, 209,535.

Flax.

To describe the stages through which flax mills have passed is also gratifying. The material is more fibrous and brittle than cotton, and its granular dust more liable to fly about from the weight and motion of the machinery. Workers in flax mills are not so happily circumstanced as those in woollen or worsted mills, for under no system of ventilation can a perfect withdrawal of fibre and dust be effected.

The process of heckling is very dusty and injurious; workers are bound to swallow impurities, and during first employment in this department, vomiting and nausea supervened.

Machinery in the drawing and roving processes is sometimes laid in one room, necessitating the working together of a large number of persons, much to their discomfort. There are said to be 109,842 operatives employed in this trade, of whom a large majority are young persons and children.

ow.

In the preparation of tow, which is the short, coarse fibre produced from flax during its cleansing, much more dust, dirt, and fibre are given off. In fact the tow-carding room is the worst department in the factory, for the workers' clothes are often loaded with molecular dust, which powerful exhaust fans cannot entirely remove. Although women have been advised to wear respirators provided for their use, they prefer to work without them in this unhealthy employment amidst dust and damp, and are sometimes covered from top to toe with thick layers of the fibre. In the spinning—a preparatory process called wet spinning, which draws the roving through a trough of warm water, is necessary to soften the fibre and to prevent its breaking—much heat and moisture are required. The process was from the first considered injurious to the health of workers, and special sanitary provision was made in the Factory Act, 1844, for children and young persons in wet spinning of flax, hemp, jute or tow, so that they should be protected from wet, and also for the prevention of the escape of steam into the room occupied by workers.

Much has been written upon this subject, and means have been adopted to fulfil the requirements of the Act in various ways, for in the absence of a clearly defined application of a remedy, all was left to the wisdom of the master. Splash-boards have now been placed in front of the spindles, leathern aprons have been provided, proper ventilation has been secured, and the temperature so reduced that the alternations from hot spinning room to outer air does not superinduce chest complaints amongst female workers. Insufficient food may have a pre-disposing tendency to the "flax fever" from which a well-nurtured child would be free.

It has been quoted in a report by an Irish certifying factory surgeon, 1875, that three-fifths of those that died in this trade were carried off by diseases of the respiratory organs. In the preparing rooms the death-rate from this complaint had been 31 per 1000, in the heckling room 11·1 per 1000, and amongst weavers 9 per 1000.

The average life of a carder was 45·7 years, with a period of employment of 16·8 years; that of a preparer 28·7 years; of dressers 16·6 years of employment; and upon analysis of the fibre it is said that the flax contained 13 per cent. of silica. Under such circumstances, the sanitary condition of flax mills should be of the deepest moment to occupiers.

In the manufacture of jute, nearly the same processes are undergone, but unattended with such unhealthy issues, for as the jute is by some manufacturers saturated with oil to render the fibres flexible, a sanitary safeguard is afforded.

It should, however, be stated, that in dry-flax spinning, the evil effects of damp and dust are avoided by the slow speed of the machinery, and by the excellence of sanitary arrangements.

The total number employed in flax and jute mills is 37,920, of whom 3,363 are children, and 3,670 young persons, who enjoy the privileges of all the provisions of the Textile Act of 1878.

It was, however, found in 1868, that in some wet-flax spinning mills, necessary precautions had been much neglected; the clothes of young girls were saturated with wet from condensed steam and from the spray thrown off by the revolving spindles; the floors were flooded, and the temperature was raised to 83° Fahr. H. M. Inspector added: "It is, however, only right to mention that in pointing out these defects, I received a ready assurance from all the mill owners that proper means would be at once taken to comply with the provisions of the statute."

In another quarter, a large firm was visited who took peculiar pains to introduce improvements in ventilation into their works. Covers were put on the hot water troughs to prevent the escape of steam, aprons or splash-boards were placed in front of spinning frames to intercept and carry off the spray from spindles, a fan was also introduced into the wet spinning room which effectually carried off the steam and hot air, and reduced the temperature to 60°.

In following up his previous recommendations, H.M. Inspector said that great improvements had been made, fans had been constructed, splash-boards set up, and heat and steam effectually carried off. The masters afforded the most willing testimony to these great advantages in promoting the health and comfort of their workpeople. Another occupier asserted two years afterwards, that he was at first reluctant to accept the proposed changes, and adopted them more from a feeling that he was bound to conform to the law than from any conviction of the good that would accrue from his doing so. However, he assured H.M. Inspector, that the result had far exceeded his expectations, and he only regretted that his workpeople had not enjoyed the benefit of these changes sooner.

In another part of the country a master spinner says, "that rather than expose his workpeople to the discomfort and injury to health by not availing himself of the improvements which had been introduced into wet spinning mills, he would abandon that part of his trade altogether."

Such evidences from owners of extensive works whose energies were directed to the preservation of the health of their workers, could not but operate beneficially upon every other wet spinner, and ultimately to a general conformity with the regulations.

In the dry spinning, where dust and fibre are given off in volumes, hoods and fans are largely used, but as yet, many mills are not adequately provided with sufficient means to carry off the excessive clouds of dust in carding rooms when the atmosphere is damp.

However, in all these cases, a remedy can be applied, and the example now set should exert its influence upon occupiers of every flax spinning mill, whether wet or dry.

Therefore, in so injurious a trade as this when unimproved in process of spinning by any mechanical means, it is very gratifying to find that the clothes of workers can be kept dry, that no accumulation of steam need be permitted, that floors need not be flooded, and that the temperature can be lowered to 62°, in fine, that the wet spinning of flax can be properly managed, and made free from the very serious evils which once accompanied it.

In concluding this portion of the subject, a valuable testimony is submitted from H.M. Chief Inspector of Factories, who as far back as 1875 referred to the improved sanitary condition of factories, to the increase of self-acting machinery, and consequent lightening of manual labour, and to the diminution of the hours of work. Mr. Redgrave remarked that (*a.*) "The atmosphere has been rendered more healthy by improved machines, which enclose the dust and fibre which they evolve from the raw material—for instance, I mentioned a cotton carding machine in use, which did not require to be ground for fourteen months, by better ventilation, by removal of offensive nuisances, by increased cleanliness. (*b.*) The wonderful improvements in the woollen manufacture, whereby the somewhat severe labour of children as billy-pieceners was entirely done away with, and in that and other manufactures, by the adaptation of improvements, whereby the force of the machinery generally is so tempered that the fragile ends break so much less frequently, whereby the machine stops automatically when one end breaks, and the attention of the child or woman has only to be directed to see that the machine is in motion, instead of having to watch each individual end, and notice when it breaks. In all of which, and in many more ways, the labour of the operative has been lessened.

"Upon the last point, the hours have been gradually reduced from 12 to 10 per day, from 68 to 56½ per week."

Therefore we are furnished with conclusive evidence that in our textile factories, great improvements have been made in the essentials to comfort in employment, and in the promotion of the means whereby health may be secured, —the crooked leg or the distorted spine as the result of factory labour has disappeared for ever, the period of pale and haggard faces of children has given way to one of ruddy and joyful countenances. The mirthful spirit on dismissal from school is absorbed in play, and happiness now largely enters into the existence of a factory half-timer.

ct 1864.

The exhaustive report of the Royal Commissioners in 1862 affords abundant testimony to the minuteness of the examinations into the sad conditions under which certain industries not then subject to factory law were conducted. Every trade that was offensive or noxious or injurious to health was brought under review, and every workshop wherein articles of personal or domestic use were made, were included in the inquiry; exposing evils of a totally different kind, and more aggravated in form, than any heretofore legislated upon, and which loudly called for immediate correction.

The passing of the Act of 1864 was the first fruits of the labours of the Commission referring to six trades, which were found to be injurious to health, and to which reference will now be made.

otteries.

The Pottery Manufacture of Staffordshire had been the subject of previous inquiries in reference to its effects upon the health of persons engaged in it. Reports showed that an habitually high rate of mortality from particular diseases in the Staffordshire pottery district prevailed, countenances were said to have been dull and cadaverous, and from a disregard to cleanliness, paralysis and a host of other nervous diseases were to be met with in all their aggavated forms, consumption was generated in the processes of scouring and ground-laying, in the sifting rooms, and in the hot-houses, which were rooms within rooms, closely confined, except at the door, and without windows. In the centre stood a large cast-iron stove heated to redness, increasing the temperature often to 130°.

In the five years 1855–9 the actual average rate of mortality from pulmonary diseases was as follows. In

Stoke-on-Trent 7·85 per 1000 males, 6·17 females. In Wolstanton 7·17 males, 7·44 females. It was also stated in the report that each successive generation of potters became more dwarfed and less robust than the preceding one; they represented a degenerated population both physically and morally; and that one form of disease peculiar to them was potter's asthma, or potter's consumption.

Such were the deadly consequences of employment in this great and successful branch of manufacture, of the productions of which the country is deservedly proud, wherein about 11,000 children and young persons under eighteen years of age were engaged, and who were shown by irrefragable evidence extending over a period of twenty years, to be employed under conditions which undermined their health and constitution, and encouraged and propagated forms of disease most productive of human suffering, and most directly leading to physical degeneracy and decay.

It will be interesting to notice one or two of the processes in this industry which were so pregnant with injury to health. The mould-runner is the boy who carries the ware on the mould into the stove room, and returns with the mould to the potter who forms the dish or saucer or plate; these stoves are ovens about 12 or 13 feet square and from 8 to 12 feet high, fitted with shelves whereon the moulds with the moist ware on them are placed to dry; the heat of these stoves varies from 120° to 148°. As soon as the potter forms his ware, the runner takes it off to the stove room, and if the number of moulds be limited and perhaps used up, so must the heat of the stove be raised, so that by drying the ware more rapidly, the moulds can be taken back to be used again. The boy is thus continuously employed from day to day amidst an atmosphere of dust, and under the influence of excessive heat. Then there are "jigger turners," who turn the potter's wheels, flat pressers, hollow pressers, throwers, and jagger makers, and amongst the boys and girls are enamellers, gilders, burnishers, printers, and transferrers, each at work on various kinds of ware, but all subject to the consequences of overwork in hot and unventilated workshops.

Therefore it was found to be an absolute necessity that practicable means should be adopted for applying a remedy to the injurious effects of this trade. It was stated by a master potter "that he had often seen a plate and saucer maker with several of his children, girls as well as boys, from eight to ten years old, running in and out of the burning stoves until the sweat literally poured down their bodies, and the poor things became emaciated and enfeebled for life. It was to prevent a continuance of this state of things that the Commissioners proposed as remedies, improvements in ventilation, a reduction of the temperature in potters' stove rooms, prohibition of overtime by children and young persons, and a securing of regularity for meal times.

The regular day's work was from 5.30 to 6 P.M., and overtime was continued to 8, 9, and 10 P.M., in an atmosphere varying from 100° to 120°.

The jigger and mould-runner are attached to one man; the jigger turns the wheel, the runner takes off the ware. A saucer maker could turn off eight score dozen saucers a week, each dozen counting 36 pieces; each piece is carried twice to and fro, and weighs 2 lbs. with the mould and bat; 2 pieces are carried at the same time, therefore each run is made with 4 lbs. Now the weight borne during the week by a barefooted runner will be 23,040 lbs., being that of the 5,760 pieces, equal to 3,840 lbs. a day of twelve hours; the distance from whirler or turning wheel to stove would be about 21 feet = 42 feet to and fro, which multiplied by the number of pieces made during a week = 80,640 yards, or 45 miles 1,140 yards in a week, and nearly 8 miles per day. Added to this, the child had to do three or four hours' extra work for his moulder without any remuneration, to the sacrifice of his health, his morals, and every domestic comfort that he would otherwise enjoy. Such was the condition of this trade to which the Factory Inspector was introduced in 1864, and to the amelioration of which he set himself to work, with such results as far exceeded all expectations. The half-time system was set on foot, meals were forbidden to be taken in the dipping house, in the dippers' drying room, or in the china scouring room, labour was being conducted under fixed regulations, and the doubts and objections of masters were gradually overcome by the knowledge of what previous Acts had done. It was also found that production had not been crippled by the withdrawal of children, nor by the limitation of hours for work of young persons or females, and that the physical, moral, and educational benefits to young workers were becoming apparent. In 1867 it was reported "that a marked feature in the trade history of the year was the erection of new and improved manufactories, and an extended introduction of machinery, more particularly in the clay making department; together with the means for preventing the inhalation of dust, thereby lightening labour and adding to the physical improvement of both young and old. In 1865, only the first year after the introduction of the Act, 1,063 half-timers were attending schools for the first time; in 1871 the number increased to 2,092 boys and 1,061 girls, who were making good progress. Steam power was now more generally used, lofty and well ventilated rooms were built, places were set apart for workpeople to take their meals in, and in one manufactory washing apparatus was supplied. Then improved forms of stoves were introduced, whereby heat was excluded from the shop, ventilators carried off impurities from the air, and limewashing was regularly done, to the delight of all classes of workers. In the subversion of the evils to which this trade was subject, it is very gratifying to note that after ten years' experience, the like aid came to the assistance of the executive as had been so valuable in times of transition of the textile Acts. Men possessed of feeling hearts and touched with a desire to assist the legislature in the removal of all and every cause which detracted from the well being of the operatives, nobly came to the front as assistants in the work, and who but for the law would probably have continued in the mode of manufacturing which they were the first to condemn. These men who so worthily advanced to world-wide reputations in their improved art, and who so heartily reciprocated the intentions of the law, would not have been slow to acknowledge that the establishment of factory legislation was none else but the cradle whence their high prosperity sprung.

cifer
tches.

In Part I. a description of the effects of employment in places where phosphorus was used in a crude state for the manufacturing of matches was given, together with a brief description of the evils attached thereto. Like many other injurious trades of a minor character, publicity excited inquiry, and although from 1833 to 1845 this trade was silently carried on, no steps were taken to prevent the inroads on health which the indiscriminate use of phosphorus produced. The consequences of employment in this industry, which in 1862 numbered 33 masters and 2,650 children, young persons, and adults, were graphically described in the report of the Commission in 1862 as inevitably exposing the persons working in them to the worst evils attending that species of employment. In the small places, for want of proper space, the sulphuring, mixing, dipping, drying, cutting, boxing, and storing were brought into close contact with one another—often in the same compartment, usually small and ill-ventilated. In proportion to the extent to which this was done, so did the effect of a powerful vapour extend to all the workers. A short time after the Act had been in force complaints of injury to health were less frequent, a separation of places where phosphoric fumes were given off was insisted on, increased ventilation was given, cleanliness was enforced, no child was allowed to be employed, and meals were not to be taken in any part of the manufacturing premises.

The dipping process was in time isolated and performed at a distance from the dipper by means of a carriage which he drew backwards and forwards over the phosphorus slab. Then the mode of mixing was changed, an earthy matter was made into a paste as a first coating, amorphous phosphorus was used, and injury to health prevented. Improvements did not stop here, for the aid of chemistry was invoked, large factories were reared, patent safety matches were made which lighted only on the box. The lucifer match maker no longer complained of aches and pains, nor were his jaws diseased, for the whole process was transformed from one of a deadly tendency to a harmless production. The total number employed in this trade was 2,650, 1,800 being children and young persons.

Most of the inferior makers were obliged to fall before the progress made in manufacturing, until the number of makers was reduced to ten, who, by improved machinery, and by every application of means as to ventilation, cleanliness, and isolation, raised the manufacture to one of excellence, in the processes of which no phosphorus whatever is present, nor is there any poisonous or dangerous ingredient used in the preparations. One has heard of "death in the tea-pot," but an instance is shown of a family having been poisoned by the accidental falling into a coffee-pot of a few lucifer matches made on the old imperfect system. It is to be hoped that never again shall such an event be possible, thanks to Mr. Albright, a Swede, the patentee of amorphous phosphorus, and to Messrs. Bryant and May for its development, which may have saved many a life and home from destruction by fire.

The employment of children is forbidden, and labour in these factories is conducted strictly under Factory Act obligations.

Fustian cutting.

Fustian, including manufactures of silk and cotton, is prepared specially by a peculiar mode of sizing, so that the cutter's knife might run the more swiftly and without injury to the fabric, between the warp and the woof. His knife, very much like a fencing foil about 23 inches long, sharpened to a superfine thinness at the end for about three inches, and covered with a sheath which leaves the point exposed, is passed along and between the texture stretched tightly on a skeleton table. It has been computed that in a day's work of fourteen hours, a man passes and repasses his arm up and down the cutting table for a distance of 20,000 yards a day, or nearly eleven miles. After a roll of cloth, about 100 yards long, has been cut, it presents a fluting in parallel lines of about six to an inch. The cutter stands at one end of the table, and dexterously drives the knife to its end along the warp, cutting through the weft which forms the cord by the union of two sides of two cuts rolled together and so fixed in the process of finishing.

At a very early age children were put to this trade, who, standing on stools, were compelled with their tiny arms to run the knife along the whole length of a 6-feet 10-inch table, which caused injury to their knee-joints and produced deformities of ancles and spines; it checked their growth and impeded their development.

This was to a large extent a domestic trade—cutters were employed at home by the manufacturer's agents. As a rule they were intemperate, and their homes gave evidences of the habits of workers, both old and young.

Often have early visits been made to these garret shops, where children partially dressed were found cutting fustian in the room which, from the night's occupation as a bedroom, exhibited a barbarous disregard to all decency. These children grew up amidst examples of vice, they had to work far beyond their strength, even to fourteen hours a day, to supplement the family means, which for his part, the parent spent in drink. It was not to be wondered at that dense ignorance prevailed, for schooling was not known amongst them, but in low-roofed garrets, in back alleys, unwashed, unswept, offensive to sight and smell, and full of dust given off by the cutting and brushing of the cloth, these children were inhumanly worked in an occupation productive of the very worst results of prolonged labour both as respects health and education. The introduction of the Act shortly produced a change in this trade also, for no child under eleven years was permitted to work, the half-time system was strictly enforced, sanitative measures were not allowed to be held in abeyance. Small occupiers in time took to working in factories properly built, the domestic character of the trade soon disappeared, to the ultimate satisfaction of masters, who were not slow to admit that legal restriction was the greatest blessing that ever befel them.

In applying the law to trades so totally different in every way to the textile manufactures, a departure was commenced, which resulted in such unexpected benefits, that the other industries reported on by the Commission in 1862 were subsequently legislated upon in the Act of 1867.

In passing onwards to the consideration of the benefit conferred on workers by an extension of factory law to trades brought under the subjective influence of the Act of 1867, one cannot leave the Act of 1864 without a special but brief summing up of the good it effected. It proved that the Factory Act system was capable of an universal application, that no sort or condition of employment could not be made amenable to its code, that throughout the kingdom it revealed a truth that in all trades there were abuses to remove, cruelties to the young to be assuaged, vicious habits to be overcome, parental cupidity to be checked, avarice of many employers to be subdued, civilization in fact to be introduced, and order, system, and sanitation, the handmaids to health, to be firmly established.

Metal trades.

The history of the industries of Staffordshire, Worcestershire, and the metal trades of Birmingham have been made known through various published reports from time to time. The numberless divisions of labour in these districts have been and are sustained by female and young labour, in unhealthy, badly ventilated, small and dirty shops. The processes of chain and nail making, japanning and finishing, screw-bolt forging, lock and key making, gun making, the rolling of iron, where great rapidity of movement and heavy labour are required, at which boys run about eleven miles a day, and all the other trades referred to in Part II., are under nearly the same trade regulations as obtained twenty years ago. The habits of the male and female adults have not been entirely transformed, nor as yet have decency and order quite taken the place of coarseness or vice. The employment of children at night has been stopped; they have been dragged into schools, and young persons are brought under regulations ensuring to them more comfort and less labour. The effect of nightwork on the health of boys led to its partial abandonment, and overtime in domestic workshops by children has not been continued. The tool grinders have been provided with fans, so that dust, grit, and metal particles are carried off; the ventilation in button and pen works, and burnishing, has been effectually set up, and overcrowding has been reduced wherever practicable.

But the influence of employments on the moral condition of the people in some branches has not shown any marked improvement, nor can much progress be expected until education shall have raised the present race of children to a higher level of knowledge, and until the salutary interposition of factory legislation shall have done its work in improving their physical condition, so as to strengthen the intellectual and moral parts of their being.

It has long been seen that overtime is injurious to masters and to men, and this growing conviction will operate strongly on the side of the young, who will be saved from accidents which boys were subject to when over-fatigued by nightwork.

The neglected homes of the South Staffordshire nailers exhibited no comfort or cleanliness, nor were they provided with proper household necessaries. A truss of straw covered by a bag, without blankets or sheets, served for a bed, and upon such, the whole family, grown up and young, would lie. It seemed impossible for any factory law to do them much good, especially whilst women were employed in callings unfit for them, mingling with coarse men whose habits and manners they imbibed, to the ruination of all the children around them, who were compelled to pass the most of their lives at the chain block or forge, and who cannot well be reformed unless every feature of their existence be altered, and cleanliness and decorum adopted.

The continuous employment of women from 8 to 10 P.M., and children of nine years old for eleven hours a day, and young persons for thirty-eight consecutive hours, is now unheard of; increased cleanliness and better arrangements are to be seen in some few of the back alleys and dirtiest back courts of Birmingham, where, insisted on by factory law, a lime-washing brush had never before been applied; some simple method of ventilation has been adopted for workers in stifling, overheated workshops, and closet accommodation has been provided separately for each sex.

To have done this within seven years after the passing of the Act, speaks much for its effectiveness, and by constant supervision directed to some of the salient evils of the trades, by the aid of education and local sanitary efforts, a more cheerful aspect may be presented in due time, when women will take their true place; and if to be employed implies necessity, that such employment may be regulated and pursued in a becoming manner, not as an object of desire for drinking men, but as a mother earning means to prevent such sights as once were seen of children wandering about ragged and shoeless, who, as soon as they could blow the bellows were sent into the forges to be kicked and cuffed, to hear language of an indecent and blasphemous nature, and soon to become familiar with the habits of degraded men.

The good of restriction has, however, been felt, and if a little leaven can only be put into the right spot, at the right time, how joyful it will be to find that our black country operatives have been brought into a community of respectable beings, and embracing the opportunities which the large educational resources of the country afford for their advancement.

Preface to 1867 trades.

The experience of the last fifteen years will have convinced us that the commercial aspect of this country has been largely developed, that our population has rapidly increased, that a corresponding improvement in productive power has followed those advances, and in proportion to the sharpness of the competition which those developments have caused, so has been the increase in the value of manufacturing property, and in the wear and tear of employers and employed. In order to work out the issues of these changes on the side of operatives only, one must acknowledge that they have been benefitted to some extent, but as a consequence of the increased activity by which that partial benefit has been secured, the law of order has been somewhat overlooked, and the progress of our workpeople towards the attainment of a condition of consistence between labour, health, comfort and morality, seems to have been interrupted.

As changes have been made in the modes of manufacturing, so have changes, equally marked, followed in the ways and habits of operatives, for if commerce has such attractions in it as to compel men to strive to their utmost to become wealthy as quickly as possible, and to cause them to exercise brain and body to the brink of premature decay, so will it be conceded that those who are employed by them must more or less become inspired with the hot haste of their masters. Luxury, too, has much to say for this increased activity; it has its little world amongst operatives, who, seeing that their employers repair to the factory or workshop not earlier than 9 or 10 A.M., fall into the same habit, and by calculation of what can be done under the piece-work system, regulate their day accordingly.

But in order to work to advantage, the corresponding hour at night must be reached before a sufficient wage can be earned, so that by the time the worker gets home it is nearly 10 o'clock, and when working overtime under legal sanction, the hour is brought up to 11, or 11.30, after sitting all day in hot, ill-ventilated workshops.

If, therefore, production be quickened by the extended use of self-acting machinery in many trades, so that by its concentration manufacturing begins and is perfected without subdivision, so will less manual labour be required, as for instance in textile mills, where it is said that 1¾ workers will now do what it required 2⅚ to perform a few years ago; therefore in proportion to the diminution of the amount of expensive labour under larger production, so has a greater amount of material been placed ready for manufacturing by auxiliary trades, thereby increasing cheap labour of the young, who are brought into competition with older hands at a less price. The impulse is visible in the cotton mill, for a mule did not run more than 1,700 to 1,800 times per day of twelve hours, but now it will travel 2,161 times per day of ten hours.

The condenser of a woollen mill will do what three machines once did, and as a Yorkshireman said a few years ago, "they would not cease till wool went in on one side and came out cloth on the other."

Then in letter-press printing labour is saved and production quickened by improved machinery, which takes off automatically, and although no greater impetus can be found anywhere than in printing offices, for the aforesaid reason, yet the self-acting system seems to be a necessity.

So with coloured litho-printing. A few years ago only one colour at a time could be printed; now, by larger machines, three colours are generally put on by a single passage of the machine.

These thoughts are suggested whilst looking over the extended area of industrial life brought under inspection by the Act of 1867, wherein thousands of women, male and female young persons, and some children are daily employed.

Some of those trades, such as metal and iron, have existed for years without any Government interference, therefore the formed habits of generations of workers had to be combatted; many are developments which the gas engine has helped into existence, others are economisers of several processes by the aid of compound machinery, whilst a large number are increases in workshops of a like kind which trade has created, and some are tributaries to fresh inventions.

Very many of them administer to our daily wants, and are influenced by seasons and fashions; the subdivision of labour is the general rule, and special considerations in regard to hours for labour and meals have been allowed, so that instead of a hard and fast line for commencing and ending work as in textile mills, the times for beginning may be taken an hour later, and extra time is allowed at night to meet the exigency called forth by the nature of the processes.

In most workshops and in some factories longer hours are permitted by the State, so that occupiers may do all they need, and workers may make up for periods of slackness. Inferentially, therefore, time is sometimes too short, production has to be quickened, extra activity must be undergone, and to render this acceptable, piece work payment obtains in many workshops; the sewing machine, that wonderful converter of what was to what is, helps master and servant to larger returns, but at what cost will be explained.

Trades injurious to health.

Some of the occupations under the Acts of 1867, 1878, may be said to be injurious to health, and care has been taken to bring before manufacturers the defects or evils which were found to be hindrances to the health of workers, and to suggest remedies. Amongst them may be classed white lead works, type founding, chemical manure works, and vitriol manufacture, drug grinding, tin plate works, glass, silvering of mirrors by the old mercurial process, cardboard enamelling, paper colouring, bronzing, and employment in salt mines. Those that are not injurious to health by reason of the process carried on, but which are rendered unhealthy for want of space and ventilation, are letter-press printing offices, book-binding, tobacco and cigar making, envelope making, and many prominent industries in workshops, such as ostrich feather, artificial flower, fancy box, frilling and goffering, boot and shoe making, millinery, costume, fur sewing for caps, and stitching of waste dyed fur skins and tailoring.

It is computed that there are three and a quarter millions of females at work daily in these industries and in textile mills, and those of them who are employed in workshops in large towns and cities are as totally different to workers in textile mills, as are the occupations in which they are employed.

White lead.

For some years past public attention has been directed to the great evils resulting from the manufacture of white lead.

As soon as the process was placed under factory regulations, the terribly dangerous nature of the occupation assumed more prominence. It seemed to be impossible to improve the system under which it was made, either in dispensing with the old stack method or in mitigating the consequences of handling the converted substance. The process is, to subject pigs of lead to the action of acetic acid placed in earthenware pots arranged in rows in a large chamber called a stack, each row covered with tan, in this way, layer after layer is laid, until the stack, a floorless chamber, becomes full. The lead remains here for about three months, when carbonic acid gas is evolved, which escapes through ventilators in the chamber; during the evolution, the lead "grows," *i.e.* fantastic crowns of white lead, or carbonate of lead, are formed from the pigs.

The removal of this white lead to the washing tanks, and from the grinding pits to the stove rooms where it is dried, and from there to the packing room, are the three stages in the process which prove so injurious to women who always do this work.

Rules for cleanliness were laid down, but whether for want of strict supervision or from carelessness of workers, no great advantage would seem to have accrued therefrom, for the evils both external and internal, such as colic, palsy, paralysis, and death from absorption of the lead fumes, were not reduced, nor were any means found to be effective in abating them.

The attention of H.M. Chief Inspector of Factories was then directed to the question of lead poisoning, and to the condition generally of persons employed, for at that time no general rules were laid down or carried out in white lead works, everything being left to the manufacturers, who, however, did provide necessaries as to clothing and cleanliness for the good of male and female workers. Influence and persuasion were all that could be used to lead men up to the true intent and meaning of the sanitary clause, which contained no special reference to such trades as this. Sufficient attention was not generally paid by manufacturers to free the employment from the serious evils which carelessness and ignorance of workers were sure to entail. Regulations were then laid down by Mr. Redgrave enabling occupiers to frame rules which should render workpeople amenable to law from disobedience to them.

The issue of these regulations seems to have roused manufacturers to an immediate consideration of an improvement in the process, for in the following year a "report on an improvement in the manufacturing of white lead was circulated," which was said to afford an immunity to workers, by a non-handling process, and by the withdrawal of poisonous gases into reservoirs. Cases of illness and of death were circulated about this time, official investigations were again made, showing that under the best arrangement of the old system, very considerable danger was present, "and that the existing state of things should not be accepted as beyond improvement"; these are Mr. Redgrave's words. Then the Factory Act, 1878, stepped in and forbad anyone under eighteen from working in a white lead works, consultations with every master in the kingdom as to the substance and form of special rules to be adopted were held by Mr. Redgrave, and in 1883 an Act was passed forbidding the manufacturing of white lead unless it be certified to be carried on in conformity with the Act, and that an official certificate accompany a compliance with these conditions. Then special rules were to be framed for each works, exhibited in them for fourteen days, and afterwards submitted for the approval of the Secretary of State.

Therefore, under so rigid a system, first by legal restriction upon masters, and then by adherence to rules for work-people, it is fair to assume that so deadly a trade may in the future be carried on under more healthy conditions, even if perfect immunity cannot be attained.

It is evident that Mr. Redgrave's words in 1882, "The careful inquiry I have made has shown me that the temporary illnesses and permanent disabilities which affect those working in white lead works, far exceed anything that has come before the public," were not lost sight of by those interested in the manufacture, for a short time ago, a publication was made of another system of manufacturing, called the "Gardner process," said to be in operation at Deptford, and which would appear to offer the very great advantage of securing perfect freedom from injury to health during the conversion of the lead to its ultimate stage of completion.

Therefore in ten years, by legislative interference and by public enterprise, the old-fashioned deadly system of manufacturing white lead has been so modified, or kept under such proper supervision, as to cause great satisfaction.

Type founding.

The process of type founding is limited to a few factories, and need not be unhealthy if conducted under proper sanitary regulations. The only injurious part of the manufacture is the polishing of the type, that is, the rubbing off of the superfluous metal, now done only by men, for being a tripartrite of antimony, tin and lead, this precaution was very necessary so that children or young persons might not be exposed to the fine dust which the rubbing gives off. Since the application of steam power to the type making machines, in each of which is a little furnace of molten metal, a greater impetus has been given to the trade, a larger number of machines are found in one room, and as a consequence, greater heat is given off. It was found in one manufactory that the heat rose to 94° from the combined effect of an increased quantity of fused metal and gas burning.

Upon representation of this evil, the principals at once accepted their responsibility, remodelled their arrangements, stripped the roofs, heightened them, inserted improved ventilators into the centre elevations, and thereby reduced the heat from 94° to 70°, which was tested at 7 P.M. in the month of November, being the period of the day and time of the year when the factory would be most highly charged.

Chemical manure.

The manufacturing of chemical manure was once very injurious to health; men's lives were endangered from prolonged labour in the grinding and mixing of coprolite and earthy matter with sulphuric acid, and in the removal of the converted mass from the settling pits.

When these works were first inspected men were obliged to cover over their mouths to prevent the inhalation of carbonic acid which the mixing chambers, not being so closed as to confine the gases on their way to the pits beneath, gave off; nor were the pits air-tight where they ought to have been, nor ventilated so as to release other gases then generated, before men entered them for clearing. So very injurious was this process that one set of workers declared that five years was the extent to which life was bearable in the clearing pits, their ashy faces and heaviness of breathing affording ample evidences of the truth of the assertion. Here also suggestions were made and willingly accepted, for improved mixing chambers were erected, so that the earthy powder and acid, both being measured, fell at the same moment into the mixer, which then was hermetically closed, and therefore gave off neither dust or gas; the pits were ventilated by a proper system, all the gases were carried away as soon as they were formed, so that upon opening the pits for clearing, these noxious fumes were not inhaled either in a pure or combined form.

These examples are quoted to show how ready scientific occupiers of very extensive works are, who know full well when a subject is put before them which deserves attention, to respond to official suggestions for improvements in a sanitary direction.

Mercurial silvering.

No more unhealthy occupation was known than the silvering of mirrors by the old mercurial process. Workers resorted to all sorts of contrivances to lay on the mercury without injury to their systems; some few escaped, whose constitutions and regularity of life told in their favour, but the majority bore upon them the effect of employment in this dangerous occupation, even to total paralysis. The Act of 1878 forbad the employment of a child or young person in any part of the factory or workshop where the process was carried on, which led to the gradual substitution of a totally different method of silvering.

The glass is now laid on blankets over a stretcher table, underneath which are steam jets, the silver is liquified and poured out of a jug, just like water, upon the glass, which in a very short time appears coated with the deposit. The silverer continues his operation until the proper thickness of metal is set. Whatever runs off from the glass on to the blankets is collected for future use. The process is said to be perfectly harmless, so that now a silvering workshop is as healthy as any other.

The employment of women in salt mines in high temperatures and under the influence of copious steam has been pronounced to be unsuitable for them, and hurtful, therefore female labour was prohibited in these works in like manner as in brickfields. The operation of the law led to the discontinuance of female labour in one large mine, and it is said that the prohibitive clause will no doubt prevent the next generation of females from engaging in so laborious an occupation. It hardly seems proper for a woman to work in a half naked condition amongst men nearly nude, or to have their babies brought to them in the steaming sheds to be suckled.

Cardboard enamelling.

The process of enamelling cardboard for playing cards, show cards, fancy boxes, &c., is allied to paper colouring and bronzing, each of which deserves to be mentioned. Ventilation and the suppression of the use of noxious material were the chief points for consideration, and as these trades have been under supervision for some time, an allusion to them may be permitted. That the former method by which the required object was attained has undergone a salutary change, cannot be disputed. Although machinery has superseded hand labour, it was found that the evils attending the old method were aggravated by the use of the dusting machine; but it had this advantage, that whilst appliances, under motive power, could be fixed for the carrying off of dust and impurity, their removal from a room where hand labour was used was more difficult, if not impossible.

No process serves better for an illustration of the value of machinery in production where health is a consideration than in this.

In the old-fashioned way, but less frequently now, the enameller was shut up in a small room, with closed windows and door; a pile of cardboard lay on one side, and a box of carbonate of white lead, or as it is called, French chalk, on the other; the left hand took a sheet from off the pile, the right hand holding the duster was dabbed forcibly into the box of chalk.

In proportion to the energy displayed so did the dust arise, and likewise when dusting, so did the chalk ascend, to fall upon the worker. Unconscious of the cloud in which she was enveloped, the woman worked away until the pile was dusted, when the polishing or glazing had to be done by briskly passing a hard brush over the surface by which the gloss was produced. It often happened that faintness succeeded this work, and when emerald greens were so treated, the worker after a few days became incapacitated for further exertion. The knowledge of the injurious effects of the process led occupiers to forbid employment for more than two days at a time. When the machine brush was introduced, dust was given off in larger quantities, which often shut out from view the forms of the men working within a few yards of each other.

On one occasion two men were examined whose voices and quickness of respiration betokened damage to the bronchial tubes; the master was summoned to the machine-room;—there he stood in the midst of the cloud, where, singular to say, he could not remain, for he was also a little touched in the wind. Now or never was the passing thought, and so it was accepted. In a month afterwards, a fan, two exhaust pipes, and a capacious hood were fixed over the brushing machines, which effectually carried off all the dust, and allowed these men to work in comfort. In another factory, where every appliance that skill can suggest is set up, a dusting machine for playing card sheets is so constructed, that the chalk is kept in a box laid across the width of the machine, and so used that one could not tell what process was being undergone. Here are examples of great improvement, and which serve for reference elsewhere wherever required.

Bronzing.

Bronze powder, consisting of metallic copper, sulphate of tin and antimony, has been used for many years in the illumination of almanacks, tin plate show cards, enamelled show cards, gaudy posters, &c., and since lithographic printing has assumed such excellence of finish and softness, bronzing has been extensively used.

It is, however, well known that printers would gladly dispense with it if they possibly could, but their customers who delight in elaborate designs will have as much gilt and colour as can well be laid on.

The mode in which the bronze powder is used, is precisely the same as in enamelling; boys are instructed in its careful using, and are required to drink milk twice daily, and not to work for more than three consecutive days without change of employment.

A dusting machine driven by power has been tried, with partial success; it is wasteful and forces the bronze backwards into the face of the bronzer, who after a few hours' work would look as if he had rubbed the powder over his head and arms.

One really effective machine has been seen at work; it is provided with a fan, which forces the waste powder away from the worker, and carries it off; so cleanly is it, that no bronze could be seen upon the outside of the machine.

The washing of face and hands before meals is insisted on, but the process is not so injurious as enamelling, nor is it done in small shut up rooms.

Arsenical green.

The use of arsenical green for producing the beautiful tint so much admired by fancy box makers, wall paper manufacturers, and artificial florists, has been happily discontinued, but it is still used in paper colouring when expressly ordered.

Paper colouring.

It is surprising to notice how unconcerned paper-colouring women are when using it,—often will their forearms be stained with the liquid containing the emerald green, which they unconsciously rub on their hair. Meals used to be taken in the workshop with unwashed hands, even the aprons, thick with coatings of various colouring matter, were not always removed.

These women were well content if the accepted antidote of three doses of milk and gin were administered daily at *proper* times, for then said they, "no harm would come of the work."

It so happened that although care was taken to ensure a compliance with the sanitary regulations so far as could be, as was the case with white lead works, nothing being specially enacted to authorise certain measures to be taken, two deaths occurred in London in 1879, one that of a woman who worked in a tin plate printing factory in laying on poisonous ingredients for impressing the plates with bright figures and illuminations, and the other that of a boy who bronzed in a printing office.

Evidence of poisoning was adduced in one case, but not conclusive in the other, but the tin plate company at once discontinued the use of dry powder, which the workers rubbed on to the plates, and by a wet and more speedy process obtained the same result, only at the partial expense of brilliancy.

Traces of injury to health from employment in these processes were so apparent, that an order was issued in 1880, forbidding the taking of meals in any factory or workshop in which white lead was manufactured, except in a room used solely for meals, or in any part of a factory or workshop where the processes of lithographic printing, playing card making, fancy box making, paper staining, almanack making, artificial flower making, paper colouring and enamelling, and colour making, wherein any dry powder or dust was used.

This regulation had at least one good result—it compelled workers in each of these trades to wash themselves before they could go to their meals.

An emerald green has now been produced containing no poisonous ingredient, and which is used by artificial leaf and flower makers, wall paper makers, and paper colourers.

Therefore we hope that the little children who are taught the art of tinting the leaves for artificial flowers, will no longer dye their hair nor discolour their skin by using pigments of arsenical green in their handicrafts.

From the foregoing statements wherein the progress of factory legislation has been traced through its various stages, as it affected the welfare of different sorts and conditions of workers, it may be conceded with propriety that the objects sought to be attained in lessening excessive work, in ensuring regularity for meal times and rest, in preventing the illegal employment of the young, in preserving them from accidents and from the effects of noxious gases or deleterious matter generated in the several processes of manufacturing, and in promoting education, have been fairly realised.

It has been shown that inasmuch as there were many trades wherein labour was more severe and the processes more prejudicial to health than obtained in textile mills, how extensions of the law to counteract these evils were nothing short of acts of humanity, and how quickly employers settled down under the guiding influence of restriction, which gave to operatives the very advantages which the legislature had intended. But when allusion is made to the multifarious industries taken in hand by the latest Act, so totally different as to people and occupations, we ought in following the success under former Acts to be enabled to show results equally favourable during these last sixteen years.

It would be instructive to learn to what extent industries have profited by sanitary legislation, wherein are no processes injurious to health, and what improvements have been made in them during the period aforenamed; to inquire if operatives in workshops enjoy fixed periods for rest and meals, if their labour be carried on under favourable sanitary conditions, and whether the Acts of 1867,1878, show, as former ones did, that progress is marking the way with milestones indicating the nearer approach to further benefits amongst another class of operatives, and which the increasing intelligence of the people are bringing to the front. But before the reply be given, it must be said that much work has yet to be done, that evils are to be overcome in which the co-operation of the people is sorely needed, and if they would but rouse themselves to a desire to assist the legislature in advancing the cause of sanitation, progress would be quickened and continuous.

Everything is tending to sanitative action, to the rescuing of the inhabitants of cities and towns from impurities, and for enabling workers to dwell in healthy homes and to be employed in healthy workshops. If the question were asked, what sanitation meant in its application to the cities and towns of our workshop population with their miscellaneous industries, where dwelling-houses are used for manufactories, where space is limited, where vitiated atmospheres abound, where work-rooms are overcrowded, where refuse is accumulated, where light, ventilation and water are deficient, where noxious vapours from ill provided closets permeate the work-rooms, where gas is excessively consumed, and where persons work more or less under the influence of some of these evils, the reply to the question would suggest that whatever sanitation *does* mean, insanitation as described ought not to exist.

If the object of this handbook were only to point out the good that has been done through certain agencies to extend the means for improving the health and strength of over eleven millions of workers in Great Britain, methinks that object would miss its accomplishment in the ultimate victory of sanitation, were only a recital given of what has been done and not that which has been left undone. It would not be safe to say that a favourable verdict cannot be given of sixteen years' strivings, but quite the reverse, nor would it be safe to say that the whole intention of the law has been universally respected. Although so much has been done by Acts of Parliament in lessening the evil effects of certain employments wherein positive injury to health would ensue from a continuance of labour in such trades without restriction, and whilst it is gratifying to know that our industrial population is so well protected in this matter, yet it ought not to be disputed that in many workshops the sanitary clause would seem to their occupiers to be too general in its terms, for although equally potent, yet not so felt, because the occupations, having no positive evidences of danger to health in regard to the thing produced, are carried on regardless of cleanliness or ventilation, but which not seeming to interfere with production, are considered by occupiers or workers as not demanding special attention unless officially directed; even the lime-washing of a workshop, that most primitive and simple of the sanitary regulations, would be neglected by many, unless certain timely hints were given. So many men seem to wait for the interference of law, or for some co-operation,—they want to have things brought before them so that their minds may be convinced of the utility as well as the legal necessity for certain improvements before they will apply themselves to a consideration of such vital importance as the ventilation or cleanliness of a workshop,—for it cannot be gainsaid that many men who have been brought up to commercial pursuits, have not given deep attention to matters not immediately connected with production. And herein lies the barrier which impedes the free course of sanitative progress. Occupiers in every epoch of industrial restriction have done what they know they should do, not so much from a sympathetic spirit as a motive power, as from legal necessity,—the law came first and a law-loving spirit followed. The schooling of children and half-time labour became an institution, but the law was its parent. After fatal accidents, or positive effects of poisonous inhalations, a master will do whatever he is asked, but no thought of the consequences of dangerous employment entered his mind until law told him it should.

If in 1867, when printing offices were first inspected, there were found to be machine-rooms underground, where machinery was crowded into small rooms, where shafting was dangerous, and space more limited than the law allowed, where a boiler and an engine were seen in one corner, and a closet without ventilation or water supply in the other,—where gas was burning all day, where the thermometer registered 85° to 90°, where men and boys working half dressed and in profuse perspiration endeavoured to give impulse to their wearied bodies by improvising a fan made of cardboard lashed on to a line shaft to cause undulations of air, would not ample proof have been afforded of the necessity for legal intervention?

Or, if a workshop containing 1,896 cubic feet, in which fifteen persons worked, who needed seven large gas burners and a large coke fire, where men sat between open windows with necks bare and coats off, and where females, worn out and languid, were finishing their work at 10 o'clock at night; would not such a workshop be also said not to be in conformity with any previous Act?

One might naturally ask if such places exist now, or to what extent did they exist; but what if he were told that to-day not one workshop in a hundred is ventilated upon any scientific system, and that many factories rely for air currents upon hoist-wells, staircases, chimneys and windows, and which are often considered to be sufficient; but so it is;—and further, even in handsome, spacious, newly erected buildings no special arrangements upon scientific plans for ensuring interchanges of atmosphere are general,—to wit, in a new building, large, airy, with plenty of window-room, is a workroom 40 feet long, 18 feet wide, 14 feet high; 36

persons work in it, 15 large gas-burners, windows open, thermometer 87° at 9.15 P.M., no ventilation unless what is afforded by windows and door, which over-heated workers will not have opened.

There can be no doubt but that the utilization of old dwelling-houses for factories and workshops is a grave evil,—it is a remnant of olden times, and continued through the increased value of property by reason of our commercial prosperity.

The wording of the Act, "so far as is practicable," induces an argument of this kind. Outside the four walls of a workshop, are the four walls of another, so what can either occupier do to enlarge his boundaries even to an inch for sanitary purposes?

The question is a serious one, and deserves very much consideration.

In order that the objections which may be raised by an occupier may be met by a due regard to the surrounding circumstances, a very modest minimum of 250 cubic feet is fixed, not by statute but by official sanction, for each person, and when overtime is being worked, 400 cubic feet are accepted, not as absolutely sufficient, but as much as could be insisted upon at the present time, although this is far beneath the standard of any recognised authority, still there are many places where this cannot be attained to; but if the 250 and the 400 be allowed to pass, and no ventilation effected, it is plain that the amount of space, so far as utility is concerned, might not be half so beneficial as a place where ventilation was secured.

The season trades are fruitful causes of insanitation and overcrowding, for many dirty workshops are found which are offsets of large producers, who employ several small men in wretched places difficult of detection. These small men become occupiers, they employ at the lowest possible price and smallest cost (for first-class workers will not be found here), and make the best bargain they can with their workers between the cost of outlay and price fixed by the master, who never sees the workshop, nor cares to inquire whether or not labour is favourably undertaken; he requires his goods to be made at a price such as an occupier of decent premises could not make them for, and by that system, which is the preservation of the link between domestic workshops and employment in dwelling-houses used as workshops, a general improvement is retarded.

If such places were faithfully described, the description would not be favourable to a fair judgment on sanitary progression or healthy employment, but the remedy will no doubt come in time, if restrictive law be righteously enforced, and if workshops properly erected and fitted for special trades be provided where the smallest masters could have just as much room as they need in properly ventilated buildings; and if every such place were inspected previous to occupation upon notice and to be certified as fit for employment therein, then would there be some tangible provision which would check the evils of employment in overcrowded, ill-ventilated, and filthy workshops, wherein closet arrangements are most defective, but wherein none but the lowest class of operatives will work. If, moreover, overtime to 10 P.M. were not permitted in any factory or workshop unless sanitary arrangements were certified as sufficient, an assurance would at any rate be given that during day employment, overcrowding would be stopped, and at night proper ventilation would be secured.

It is possible that such an insistance would prove the value of overtime to such a degree that either it would lead to its partial abandonment (now gaining favour), or to the quickening of sanitary progress.

In considering the applicability of these remarks, it must be borne in mind that three and a quarter millions of females are working daily in factories and workshops, and that a large proportion is employed in old dwelling-houses, consisting of numbers of small and over-heated rooms. It is no easy matter to undo the usages of generations or to remove from a workshop the ingrained habits of masters or workers—and in dealing with sanitation in workshops a greater importance attaches to it from the closeness in many ways that its consideration would apply to the homes of the poor, and domestic workshops.

The Act of 1878 has done much good in effecting improvements in many classes of trades, such as in the erection of ventilating roofs and shafts, in the removal and alteration of closets; and if all occupiers could be led to a consideration of the value of sanitation, even though structural defects cannot be overcome, a very great advancement would soon be seen in the removal of what is to-day so objectionable.

Printing offices were described twenty years ago as very bad, composing rooms overcrowded and ill-ventilated, reading closets almost stifling, machine rooms often extremely dirty, close, and unhealthy, heat of steam printing very deleterious in close cellars, and some were described as regular dens. But to-day can be seen many printing offices magnificently built, with every modern improvement, and fitted with every sanitary appliance, with light, space and ventilation abounding, without the old underground machine room; where the engine and boiler are in their proper houses apart from the workrooms, and where employment is carried on in every way satisfactory.

There are many other offices of the olden type, which have been modernised as far as can be, to supply the need for larger machinery, although not so lofty or capacious as later buildings, yet, being erected for the purpose, are not objectionable; but there are very many of the old dwelling-house offices left which never can be put in conformity with the law, for they are circumvented in dense localities, and are small, dark, dirty, and whose occupiers are struggling to keep pace with the progression of others, where machinery is crowded, and the want of ventilation is felt, where, however, the labour clauses are respected, but the conditions under which work is carried on are very objectionable. Amongst the largest printers we find the old state of things dying out, for it is self evident to them that perfect consistence of every arrangement, whether of preservation of life and limb, or regularity in employment, each and all contribute to the increase of manufacturing, and as yet no case can be found where those men have lost by their outlay for such improvements.

In bookbinding, the next most important industry, where a much larger number of females is employed, the comparison is also in favour of great improvement. What were called "garret masters," that is the little men who were auxiliaries to large binders for doing common work, in very objectionable places, have died out, from the extended mode of manufacturing, the superiority of appliances, and capacity of the many factories which have been built; the new and expeditious method of stitching books and pamphlets by machinery has added to the employment of females, who are in the first-class establishments very neatly clad, respectful in manner and in conduct, and cleanly in habits; the working in the same room of males and females is now quite unknown, and in most of the factories meal-times are given at different periods.

The change for the better in bookbinding rooms is very marked, but yet some of the old ones remain with all the faultiness of the dwelling-house, which is most felt when the overtime takes place during winter months before Christmas. In some of them, the air is breathed and re-breathed by numbers of females in closed rooms, as proved by the following readings taken in the months of October, 1883, and in February, 1884, in dwelling-house printing offices and bookbinding factories.

In October, 1883, between 7 and 8 P.M. the thermometer registered 80°, 86°, 84°, 84°, 86°, 83°, 81,° in bookbinding and letter-press printing factories, and in February, 1884, between 9 and 10 P.M., during the period of overtime work, the registered state of the atmosphere was 84°, 85°, 84°, 91°, 87°, 80°, 86°, 92°, 87°, 92°, 92°, 86°, in the same class of dwelling-house factories, not one of which was, or is, provided with any system of ventilation by which the products of combustion of coal gas could be carried away. Even higher returns might have been given for laundries, factories, and workshops, in which a large number of women are employed in an over-heated atmosphere amidst coke fires, built up to heat drying stoves to a red heat, and close to which these women work. I have seen them at 10 P.M. thoroughly exhausted and faint.

It may be said that throughout the industrial towns, wherein are factories and workshops of the miscellaneous character, very great improvements have taken place, which can only be attributed to the extension of trade, and to the largest manufacturer becoming still larger; but when the small occupiers are considered as to their ability to satisfy legal requirements, the task is very difficult either to suggest or to complain; for very much had to be done to pave the way for a fair consideration of the great necessity for sanitation—the great work of instruction could not be undertaken *per saltum*—and therefore the sanitation of factories and workshops did not at first advance with equal rapidity, except in those trades which bore distinctive traces of real injury to health.

Whatever regret may be expressed at the employment of thousands of females in places unfit for them, in such trades as straw-board cutting, frilling, goffering and pleating, laundries, costume makers, mantle manufacturing, corset makers, cigar manufacturing, valentine mounting, book-binding, envelope making, machine ruling, tailoring, especially when overtime is worked, regret might justly be turned into dissatisfaction if a solution could be found and not acted on. In every period of factory history, ameliorations were gradual but sure—positive evidences could be and were speedily removed, as in the pottery trades; but it has been only since 1867 that sanitation proper has been presented, not to factories only, where it can be enforced, but to a host of these dwelling-house workshops wherein are carried on the whole auxiliary work of the kingdom; and although overcrowding has been diminished and many places made better, still in the aggregate a large amount of unhealthy labour is undergone, which seems to defy the power of the law to remove. But if it could but enter into the minds of occupiers of many workshops where ventilation is deficient to remember that a Tobin tube and a Howarth ventilator will effect wonders, and that by a little expense and contrivance the worst evils of insanitation may be checked, they could then work on more pleasant lines, to the advantage of themselves and their hands, and in due time, with the example of the fair progress now around us, they may be led to see that squalor, dirt, and want of fresh air ought not to be the conditions under which our industries are carried on; but that the laws of health are paramount to every other consideration. Here one should stop to say, that workers in some classes of workshops contribute very much to uncleanliness which disheartens many a well disposed occupier. Some workers will spoil, destroy, and daub themselves over with substances on which they work, regardless of the influence they exert: whilst others are tidy and cleanly, showing evidences of early formed habits at home; and it is fair to assume that no legislation can be so potent as to prevent a continuance of ills that are preventible by persons themselves in the exercise of the individual will, built up from infancy by example in their dwellings: for if by persuasion, education and enforcement, true principles can be infused into dwellers in their homes, then might we expect to find our operatives growing up in cleanliness of intention, and under the incentives of example and thrifty habits our workshops would be conducted under more favourable circumstances.

The only industry which has not yet fully accepted the benefits of sanitation and restriction is the East End tailoring trade, comprising Jews of all nationalities, who in their sad condition, and with a superabundant supply of labour, work out their toilsome lives in unhealthy and dirty workshops, regardless of comfort and heedless of the advantages which an adherence to factory law would bring them.

No greater squalor in homes can be seen, no more unhealthy workshops can be found. Persuasion and argument do not avail ; but, employed under a system of bondage, their manhood is degraded and their independence is dethroned. Meetings have been held, influential persons have addressed them, the value of restriction on labour has been expounded, and therefore in time it may be that these 18,000 tailors and tailoresses may be brought into the fold of commercial citizenship.

The last Factory Act, passed in 1883, referred to white-lead works and bakehouses. Both these trades were specially legislated for, on account of disclosures made concerning them.

In 1881 a report on the condition of London bakehouses was issued, which took people by surprise. The finding of dirt filth, open sinks and closets, the roosting of fowls over a trough, the keeping of rabbits in bakehouses, the overrunning of cesspools into them, so horrified the country that attention could not fail to be attracted. Therefore this stringent Act was passed, which enacts :

1. That no water-closet, earth-closet, privy, or ashpit shall be within or communicate directly with the bakehouses.

2. Any cistern for supplying water to the bakehouse shall be separate and distinct from any cistern for supplying water to a water-closet.

3. No drain or pipe for carrying off fæcal or sewage matter shall have an opening within the bakehouse.

And that the medical officer of health shall have power of entry and inspection and of taking legal proceedings.

The effect of this Act has been exactly similar in its restrictions upon all previous occupations, men's inventiveness was sharpened : ingenuity was evolved, machinery was introduced, production upon improved principles established, and the people are the gainers—for now factories are being built for making bread by machinery, which in time must quicken the workshop bakers to the adoption of the sanitary regulations required by law.

Therefore people may settle down to their wonted composure as to the quality of the bread they use, not as unconsciously eating unwholesome food, but satisfied that the "staff of life" is now made under scrupulously clean conditions, and that the state of every bakehouse shall be compelled to bear the test of the legal standard of 1883.

PART IV.

VENTILATION.

THE meaning of the term "ventilation" as applied to factories and workshops is extensive. In textile mills it means the removal of dust, fibrous matter, and impurity generated in the course of manufacturing. In the trades under the Act of 1864, it refers to the removal of noxious vapours, of excessive heat, of dust from various processes of grinding, which if not prevented would prove most injurious to workers.

It has been shown that remedies have been successfully applied to most of the evils consequent on manufacturing in all trades under the extended Act of 1867, but in its application to workshops it bears a different meaning, because its need is felt in other ways.

Where workers have suffered from the inspiration of fibrous, mineral, or earthy dust and grit, mechanical means have been effectually used to prevent it, but where workers are employed in large numbers in workshops without any proper ventilation, then another remedy suggests itself for the purpose of purification rather than for removal. The evil to be overcome is serious and grave. The china scourer, or the shoe tip grinder, or the emery polisher, or the ivory turner, runs in and out during intervals of work ; but the operative in a workshop, especially the female, remains there all day without change, and is therefore in that respect not so favourably placed. The Act of 1867 presented to us entirely new features in legislation ; experience in the older processes taught masters that sanitation was good for them, they found that ill-ventilated workshops did not pay, their goods were spoiled, and time was lost, and that the money spent in ventilation increased production, reduced sickness, and secured health.

These facts have had to be instilled into the thousands of masters whom we met under the present law, and who, like their predecessors, cared not to bestow any great concern upon the welfare of workers, only so far as it directly affected the stern relationship which existed between them in regard to production.

Factories and workshops were found wherein limewashing was scarcely ever thought of. The rudiments of sanitary law were not even approached, work was done in places unfitted for it, and as small men, actuated by the activity of the period, were anxious to become employers, so was labour undertaken where healthy conditions were absolutely wanting. What would be said of a workshop wherein forty females were at work, under which horses and cows were stabled, and which was a converted hayloft?

Having shown what diseases workers were subject to under the trades specified in Parts I. and III., and what means were adopted to remove the causes, we will proceed to consider the condition of factories and workshops with which people are more familiar, and which came under restriction in 1867, 1878.

The using of converted dwellings for workshops was, to find closets in the workrooms, which, as sufficient for a family, was deemed to suffice for a manufactory—not ventilated nor provided with such appliances as would prevent the permeation of sewer gas into the workrooms; to find no provision made against the concentration of gases which sewage largely gives off, nor any ventilation scientifically provided so that currents of gases might not be conveyed into the midst of workers, because many of the drains in workshops which were dwelling-houses were in direct communication with the sewers, and consequently there was every possibility of a spread of deadly emanations amongst the workpeople. Therefore, instead of having "Health in the Workshop," such a state of things would more fitly be described as producing "Death in the Workshop."

Ventilation may be considered under three heads: Mechanical power required to carry off impurities generated in process of manufacturing; mechanical means to carry off noxious gases and vapours; ordinary means for ventilation in workshops where no machinery is used.

I shall confine my remarks to the last, inasmuch as the two first have been disposed of. Nearly all the evils of insanitation in workshops are to be traced to the conversion of dwelling-houses into manufactories, wherein as many as sixty persons have been found in a ten-roomed house, each top room not exceeding in cubic capacity 1,728 feet, with six to eight workers in each, and a gas jet for each two, where the temperature at 8 P.M. has been found to be 90°, where the windows were shut, air breathed and re-breathed, and so vitiated that females have been found quite worn out; and in those workshops where the sewing machine is used, workers suffer most from the strain to their eyes in following the rapid motion of the needle, propelled by the feet, with their heads inclined to their work, and close to which the gas is burning. Such employment is far more trying and laborious and hurtful than any to which workers in textile factories were subject, and whose hours of labour are not permitted to be prolonged as are those under consideration.

Like evils can be seen in printing offices which once were dwelling-houses, for of necessity the work must be done, and all that administers to production is primarily considered, but the importance of ventilation is very often unthought of. The composing room is generally at the top of the house, where light is indispensable to compositors, therefore windows in the roof or in other places of advantage are put in, but the room is frequently overcrowded and very hot.

In the machine room gas burns all day, the ceiling is not more than eight feet high, and at night the heat is oppressive from engine and boiler and numbers of gas jets.

It is very evident that no small difficulty presents itself, and one which can only be dealt with in so cautious a manner as will not seriously interfere with the occupier's trade, or deprive him of the opportunity of keeping his workers together. Times have changed, for previous to 1833, the greatest evils were those caused by continuance of long hours and by want of sufficient rest; now we have to grapple with insanitation in industries which administer to the consuming wants of the world. It cannot be said that the principle of restriction and sanitary legislation is not accepted and supported by willing obedience, for its elasticity of arrangements to suit each class of trade has drawn people to a unity of conviction as to the merits of the whole code; but what is required is a greater regard for matters which make up the *summum bonum* of men's lives, and an advance in the notions of the duties of masters to men.

In order to show how very necessary pure air and good ventilation are to the well-being of those employed in factories and workshops, it will be well to devote a few remarks to the composition of the air. In large open spaces the air we breathe is little liable to change in the proportion of its chief constituents, oxygen, nitrogen, and carbonic acid.

This singular regularity in the composition of a merely mechanical mixture of gases is due chiefly to the reciprocal action of animals and plants upon it, to the operation of the law of diffusion of gases, and to the influence of air currents.

Animals inhale nitrogen, and oxygen, but expire nitrogen, carbonic acid, a little residual oxygen, and watery vapour; plants, on the other hand, inspire carbonic acid, and under the influence of sunlight separate the carbon from it and exhale the oxygen.

Under the most favourable circumstances, the air of an inhabited room cannot be maintained in as pure a state as the external air, therefore the object of ventilation is to keep it so pure that it shall not be injurious to health. This can only be attained by a constant supply of fresh air, the quantity depending upon the amount of impurity to be removed.

The chief point, therefore, to be determined is, what is the maximum amount of impurity consistent with the maintenance of perfect health, or, in other words, what amount of carbonic acid shall be accepted as the maximum standard of permissible impurity. Dr. Parkes has given it as his opinion that, allowing four volumes as the average amount of carbonic acid in 1000 volumes of air, the standard ought not to exceed ·6 per 1000 volumes, because if this ratio is exceeded the organic impurities as a rule become perceptible to the senses.

With a ratio of ·8 ·9 or 1 per 1000 volumes, the air smells stuffy and close, and beyond this it becomes foul and offensive—so that when people speak of good ventilation, they mean, without knowing it, air with less than ·07 per cent. of carbonic acid.

Assuming, then, that ·6 of carbonic acid per 1000 is accepted as the standard of maximum impurity, the question comes to be, how much fresh air must be supplied per head per hour to keep the air below this standard?

It is evident that the air of a room requires frequent renewal in order to prevent the accumulation of carbonic acid, from the fact that a man expires about sixteen cubic feet of air per hour, and about one-thirtieth of this volume is carbonic acid. Illuminating materials use up air: the ordinary gas burners consume three cubic feet of coal gas per hour, and this quantity of gas renders about 3,600 cubic feet of air impure—therefore an ordinary three-foot gas burner uses up more air than three grown up persons.

In a variable climate likes ours, the allowance of cubic space is a most important element in any scheme of ventilation, which should be ample enough to permit of a sufficient supply of fresh air without creating injurious draughts, and yet not too large to interfere with the maintenance of a sufficient and equable temperature during cold weather.

When artificial ventilation is provided, and when the fresh air can be heated before entering, it may be as low as 400 cubic feet, but even then the ventilating arrangements must be much more perfect than they usually are. In the case of healthy adults the standard allowance may also be considerably lessened if care be taken that the free entrance of fresh air at all hours and in sufficient quantity shall not be interfered with.

Unfortunately the question of cubic space is a question of large outlay, and hence the desire to economise tends to curtail the minimum, not within safe limits, but within limits that will not be attended with glaringly injurious effects.

It is fair to ask, what are the diseases produced by overcrowding and bad ventilation?

By far the most important of this class is pulmonary consumption, which is much more under the control of sanitary measures than is generally believed by the public. The following interesting fact will confirm this.

In the celebrated report of the Army Sanitary Commission, published in 1858, it was proved beyond all doubt that the excessive mortality from consumption amongst soldiers, and in particular regiments, was due to overcrowding and insufficient ventilation. Previous to that inquiry the cubic space per soldier in the barracks of the Foot Guards only amounted to 331 cubic feet, and the mortality from consumption was as high as 13·8 per 1000.

In the Horse Guards, on the other hand, with a space per man of 572 cubic feet, the mortality from consumption did not exceed 7·3 per 1000. It was found that consumption prevailed at all stations and in the most varied and healthy climates, the vitiated air in the barracks being the only condition common to all of them. In consequence of this excessive mortality, the Commissioners recommended that the cubic space allowed per man in barracks should be increased and the ventilation improved, with the result, that from the time their recommendations were acted upon, the number of consumptive cases occurring at all these stations materially diminished. Indeed it has been fully established that not only consumption, but other lung affections, such as inflammation of the lungs and bronchitis, are generated under like conditions. Lesser ailments arising from breathing rebreathed air are heaviness, headache, languor, and in some cases nausea, and a continued existence under such conditions causes persons to become pale and partially to lose their appetites, and after a time to decline in muscular strength and spirits. The breathing of the products of combustion of gas frequently produce these ailments, and bronchial affections are often attributed to the change from the hot room to the cold air, and are also probably due to the influence of the impure air of the room on the lungs.

Our legislators have not as yet appeared to grapple successfully with the question of cubic space, probably on account of the expense involved in it. This is apparent from the absence of any mention of a fixed minimum cubic space for workshops in factory legislation up to the present time, although as heretofore stated, a minimum of 250 cubic feet during day employment, and of 400 cubic feet during night employment is insisted on.

An important point in determining the superficial area which shall be allotted to each person is the height of the room. At present the great majority of factories and workshops sin grievously in this respect, and consequently become intolerably hot and unhealthy when the gas is alight.

A minimum height of 10 feet and a maximum height of 16 feet ought if possible to be made obligatory in the interest of public health, inasmuch as any calculation over 16 feet, while of little value as air space, tends to give a fictitious idea of cubic space, while it reduces the superficial area too much. Although it is duly provided by the Factory and Workshop Act, 1878, "that factories and workshops shall be ventilated in such a manner as to render harmless, so far as is practicable, all the gases, vapours, dust or other impurities generated in the course of the manufacturing process or handicraft carried on therein that may be injurious to health," nevertheless the condition of these places is left to be governed by other than definite restrictions, for in so wide and difficult a question as ventilation in its application to hundreds of different kinds of industries, and to many thousands of buildings used as workshops, an insistance on specified regulations would enable inspectors to proceed on lines laid down and which could admit of no possible misconstruction.

Since the passing of the Act of 1878, one case of insanitation has been raised in the City of London by one of H.M. Inspectors of Factories *v.* a bookbinder, "in that his factory was overcrowded in such a manner as to render it injurious to the health of persons employed therein." It was shown at the time of hearing that the question was one of great public importance, seeing that thousands of women were engaged in labour in London workshops which were unfit to contain the numbers found in them, and as a consequence their health was endangered.

In this factory were found 26 females in one room which contained 3,560 cubic feet of air, giving only 137 to each person; this condition of things was much aggravated by the absence of any means of ventilation except by windows on one side of the room, which were of necessity closed in cold weather, when the insanitary state was further aggravated by the lighting of the room by eleven gas burners, which reduced the available space to 60 cubic feet per each worker.

The certifying surgeon was called to give scientific evidence in confirmation of the charge, and who clearly proved that the factory was not kept in conformity with the law. The magistrate, when imposing a penalty, decided that a minimum space of 300 cubic feet should be allowed to each operative.

It may conduce to the information of occupiers of workshops if a brief allusion be made to the various modes of ventilation which are applicable to factories and workshops.

1. By taking advantage of the ordinary currents of the atmosphere.

2. By supplementing the effect of the ordinary current by generating heat in shafts, flues, or chimneys, so as to cause movement.

3. By direct propulsion of the air by fans or pumps, either to draw into extraction shafts, or to force it into the room.

All ventilation is intimately connected with difference of temperature, and therefore the movement of the air by the two first-named methods is dependent upon temperature.

The comfort of ventilation depends upon letting the air flow into a room at such a temperature, with such a velocity, and in such a position as will prevent the occupants from feeling any sensation of cold or draught. The velocity of the air as it flows in and out of a room as measured at the openings for admission or exit should not exceed one foot, or at most two feet, per second, for the reasons aforenamed, and because a low velocity is favourable to the uniform diffusion of the incoming air. When the *extraction* is effected by means of a heated shaft, the requisite velocity may be obtained by a difference of temperature between the inside and outside air of from 30° to 35° Fahrenheit.

The velocity would be regulated by the size of the inlets, outlets, and extracting shafts, as compared with each other respectively and with the quantity of air to be supplied and removed, which quantity would depend upon the number of occupants of the room to be provided for, and the amount of air to be allotted to each, and upon the number of lights and other causes of impurity.

The openings for the inlet of air should be above the level of the heads of the persons occupying the room, and the inflowing air should be directed towards the ceiling, where it soon ceases to exist as a distinct current, and mingles with the general mass of air.

The simplest way of obtaining change of air in a room is to take advantage of the movement in the air produced by changes of temperature, or by the action of the winds.

In every room in which there is an opening at the upper part out of which the warmed air can pass, and an opening either level with it or below it through which fresh air can flow in, the system of ventilation by difference of temperature will operate.

Various forms of window-pane ventilators are in use, the best of which are the Hopper ventilators, but these are only as makeshifts, for it is preferable to adopt ventilation independent of window openings.

Where a room has two outside walls, and is provided with openings on both sides, the inflow and outflow of air is almost certain to go on continuously in consequence of the movement of the outer air, which is rarely at rest. The Sherringham valve inserted at regular intervals in the wall about eighteen inches from the ceiling on both sides of low rooms, or about ten feet from the floor of lofty rooms, is the most convenient form of ventilation for rooms so constructed.

Where rooms have only one outer wall, other conditions prevail, and it will be necessary, in addition to the openings in the outer wall, to carry a shaft from the ceiling to above the roof, surmounted by a cowl or Archimedian screw ventilator.

A plan has been advocated by Dr. Stallard which appears to possess some special merits beyond those of mere novelty. He proposes that the ceiling of every workshop should be covered with zinc or oiled paper pierced by numerous small holes. Above this perforated ceiling, and between it and the roof, or between it and the next floor above, there should be a free space or air chamber open to the atmosphere on all sides.

This plan, while it would not interfere with ventilation by open windows, nor with ordinary methods of warming, would give full play to the different modes of natural ventilation, and is intended to supply as nearly as possible the conditions of living in the open air, summer and winter, without exposure to extremes of weather.

Then the Tobin system of ventilation has received much attention ; it is simple and effective, introducing fresh air by means of vertical tubes carried for a certain distance up the walls of a room so as to obviate any discomfort arising from down draught.

In rooms with windows only on one side this is a very convenient method of improving the ventilation.

The most suitable method for ventilating domestic workshops is probably that devised by Mr. Hinckes Bird, which consists of raising the lower sash of the window two or three inches and filling in the opening under the bottom of sash with a piece of wood. This leaves a corresponding space between the sashes in the middle of the window, through which the entering current of fresh air is directed towards the ceiling.

Hitherto allusion has been made to simple ventilation only, but a very important branch of the subject remains to be noticed, *viz.* artificial ventilation and warming.

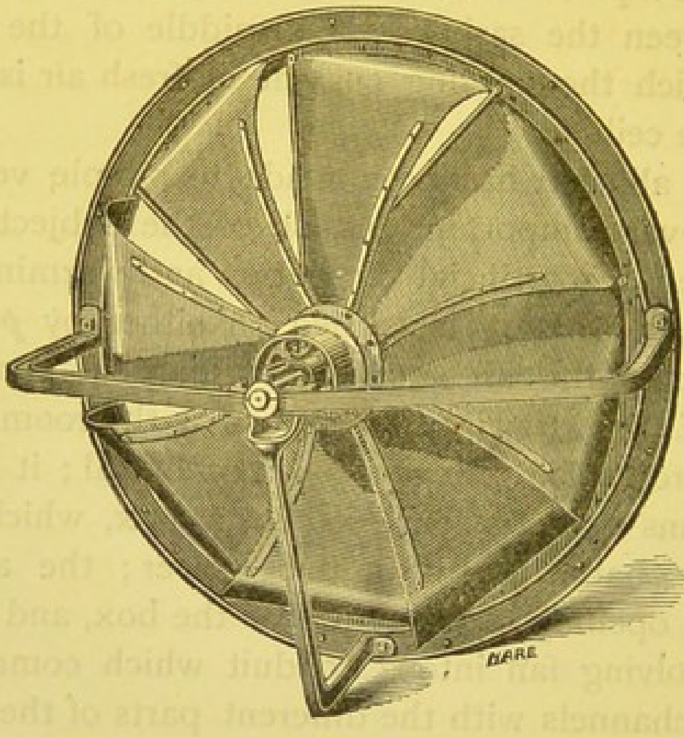
Artificial ventilation is carried on either by *propulsion*, *i.e.* by forcing the air into and through a room, or by *extraction*, *i.e.* by drawing the air out of the room. Ventilation by propulsion is invariably mechanical; it is carried on by means of a fan enclosed in a box, which can be worked by hand or by motive power; the air enters through an opening in the centre of the box, and is thrown by the revolving fan into a conduit which communicates by proper channels with the different parts of the building. In factories and workshops, in addition to the purposes of ventilation, currents of air are often required to blow away or extract dust.

For this purpose it should be remembered that for dust, the openings should, generally speaking, be near to the floor, and for foul air near to the ceiling.

A short time ago I was favoured with an invitation to view the working of a propeller lately introduced from America, and known as "The Blackman Air Propeller," (see illustration), which so pleased me that I examined its construction and mode and power of propulsion.

It may be of interest if I note that it seemed to me to have a special merit in bringing power to bear with the east possible waste. I am told that it will remove impurities at the rate of 10,000 to 15,000 cubic feet per H. P. per minute, for by its construction the air is drawn in over the whole of the periphery and one side, whilst the other side is used for discharge—

The entire surface of the wheel is used either for feed or for delivery, and its size and weight consequently reduced to a minimum—It is simple in construction and can easily be applied to any building.



Ventilation by extraction is effected by the use of shafts-tubes, and extractors as already referred to; a fire will also be effective in heating a current of air equal in height and area to the capacity and height of the chimney; this column of air ascends, and cold air rushes in along the floor, under, over, and through the fire, to restore the equilibrium.

It is always desirable where possible to make special arrangements for carrying away the products of combustion of illuminating materials, and this can be easily accomplished, by having a long tin tube provided with a funnel-shaped opening over the gas jets carried between the joists above the ceiling and communicating with the chimney or open air. I have suggested this method for carrying off the products of combustion with much success on many occasions, for the principles of ventilation by gas lights are in general so easy of application, and the advantages to be gained are so manifest as regards health, that it is surprising they should be so greatly neglected.

Finally, it may be stated that for factories wherever there is machinery, artificial ventilation, whether by propulsion or extraction, is certainly most convenient and economical. Regarding the relative position of inlets and outlets, if the air is not warmed before entering, the inlets should be 9 or 10 feet from the floor, and so constructed that the cold air will impinge against the roof before falling into the room.

The outlets, as stated above, are best situated in or near the ceiling, not only because air vitiated by respiration tends to ascend on account of its lessened density, but because experiment proves that, given the same extractive power and the same size of outlet, a greater volume of air passes up the shaft when the orifice is near the ceiling than up one whose opening is near the floor.

All foul air flues should be as nearly air-tight as possible and not external, because in cold weather the air becomes cooled as it ascends, and unless the extractive power is very considerable, the increased weight of the column of air by loss of heat will counteract the extractive force. Where there is no system of artificial extraction, it thus often happens that outlets become inlets, and inlets become outlets.

Dr. Parkes has pointed out that in this country a size of 24 square inches per inlet per head, and the same for outlet, is the one best adapted to meet common conditions.

The authorities to which I am indebted for the foregoing information are, Parkes' "Practical Hygiene," an article on "Warming and Ventilation," by Douglas Galton, in "Our Homes;" Wilson's Handbook of Hygiene; Manual of Public Health for Ireland; Dictionary of Hygiene and Public Health, by Wynter Blyth.

Seeing that sanitation is so defective in some of our dwelling-house factories and workshops, from various causes, and chiefly for want of due ventilation, these remarks are submitted for the guidance of occupiers of all classes of workshops, who can for a nominal outlay so improve the atmosphere of their workrooms as to preserve the health of their workers, and where numbers are employed, especially during overtime, the constant renewal of fresh air may enable them to complete their tasks without feeling the discomfort which the breathing in of vitiated air must produce. The causes of defective ventilation, and the remedies for it, have been so fully explained by many very eminent men, that it cannot be said we are deficient in knowledge thereof.

Generations of masters have done their duty in ameliorating the condition of workers in factories and workshops, and surely in these days of enlightenment, the important relation of master to man will lose none of its sympathy even amidst the difficulties which sometimes encumber it. It has been said that factory legislation is not a permanent institution, but potent for good only so long as the claims of labour and the rights of the poor shall fall short of that amount of attention which they deserve; but whilst it does exist, there will be no fear of its losing one jot of its power, but will assuredly go onwards to do its appointed work, "conquering, and to conquer."

It has been shown that for years past, an increased solicitude for the welfare of the working classes has arisen at certain epochs of our industrial life, and that men who viewed the human family as one body corporate, administering to each other's necessities, and who were convinced of the " Indigens per se," did, by untiring efforts, secure to us, benefits that have proved blessings to our people, and which have progressed under the enlightenment of a prosperous nation, until to-day we can satisfactorily revert to eighty years of experience on factory legislation, and behold in it a monument, high and glorious, erected to the victory of freedom over oppression and vice, and from that monument we can look round upon an extended area of our producing power, and from the means at our disposal provide such effective remedies to our present wants as will, without conflict as of old, but with a happy consensus of all parties, achieve a still further success in proportion to our need.

> "Turn round, and from this height look back upon
> The town, from it's black dungeon gate forth pours,
> In thousand parties, the gay multitude,
> All happy, all indulging in the sunshine!
> All celebrating the Lord's resurrection,
> And in themselves exhibiting, as t'were
> A resurrection too—so changed are they,
> So raised above themselves, from chambers damp
> Of poor mean houses—from consuming toil
> Laborious,—from the work yard and the shop,
> From the imprisonment of walls and roofs,
> And the oppression of confining streets,
> And from the solemn twilight of dim churches—
> All are abroad—all happy in the sun."
>
> ANSTER'S *Faust.*

ON

VENTILATION, WARMING, AND LIGHTING

FOR

DOMESTIC USE.

BY

CAPTAIN DOUGLAS GALTON, C.B., D.C.L., F.R.S.

CONTENTS.

PAGE

VENTILATION AND WARMING 551
Purity of air 552
Ammonia a measure of impurity 552
Effect of smoke on town air 554
Filtration of town air 558
Impurities caused by human breath in closed space . . 561
Humidity and temperature 563
Volume of fresh air required for ventilation 565
Relation which size of a room bears to ventilation . . 567
Cubic space and floor space 568
Movement of air 569
Rate at which fresh air should enter a room through ventilating openings 570
Simple methods of admitting air 572
Watson's ventilator 573
Movement of air in vertical shafts 574
Courts 575
Sheringham's ventilator 577
Ventilation by fans 578
Movement of air caused by heat 580
Transference of heat 582
Heat—Conditions of various methods of warming . . 585
Open fires 587
Ventilating grates 588
Effects of various forms of grates intended to prevent smoke 594
Close stoves 596
German stoves—Doulton 598
Danish stoves—Reck 600
Warming by hot air from the basement 602
Warming by hot water pipes from a central boiler carried through the house 604
Perkins's high pressure system 605
Steam heating 607
Heating by gas. 608
Heating power of different forms of gas apparatus . . 609
Direct application of gas to warm fresh air 610
Application of gas lights to warm fresh air 612
Precautions in making inlets for fresh air 613

PAGE
LIGHTING 615
Artificial light depends on incandescence 615
Relation of supply of air to brilliancy of flame . . . 617
Effects of combustion of substances for producing artificial light on air in a room 617
Relative cost of candles 621
Effects of variations of pressure in a gas main on purity of air of a room 622
Gas governors 622
Enrichment of gas by hydro-carbons 626
Air gas 626
Hygienic forms of gas lights 626
Sun lights 627
Globe lights 627
Regenerative gas burners 628
Incandescent gas burners 631
Relative cost of gas 634
Increased effect of lamps by use of reflectors . . . 634
Electric lighting, arc light 635
Incandescent electric light 636
Storage batteries 637
Heating combined with electric lighting as a means of economy 639
Conclusion 640

ON VENTILATION, WARMING, AND LIGHTING FOR DOMESTIC USE.

ONE of the most interesting questions of domestic sanitation is how to procure pure air in the house with adequate warmth and light.

VENTILATION AND WARMING.

Ventilation and warming are intimately connected, and appropriately form one division of the subject, and may be most conveniently treated under the several heads of—

1. Purity of air.
2. Movement of air.
3. Warming of air.

1. *Purity of Air.*—The first condition of ventilation is to obtain pure air outside the house, and then to introduce that pure air inside.

Air is the great sanitary agent in nature. Organic matter is everywhere present. At each respiration we throw out from our lungs organic matter. All this is subject to putrefaction, that is to say, to undergo changes by means of the action of various organisms.

Hence putrefaction is one of the purifying agencies of nature, but it produces vapours or gases injurious to health, which are counteracted by thorough oxidation.

Dr. Angus Smith, whose recent death in the midst of most important labours is a matter of the deepest regret to all sanitarians, says that a current of air either carries away the organic matter with it, decomposing it and turning it into gases, or, if it were not possible for the oxygen alone to do this, it might happen that the oxygen destroys those minute forms which have been shown to be concomitant with putrefaction and decay.

Ammonia is present wherever there is organic matter. It comes from all living organisms, and is equally necessary to build them up. It is therefore present wherever plants or animals grow or decay. As it is volatile, some of it is launched into the air, on its escape from combination, and in the air it is always found. As it is soluble in water, it is found wherever we find water on the surface of the earth, or in the air, and probably in all natural waters, even the deepest and most purified. As a part of the atmosphere, it touches all substances, and can be found on many; it is in reality universally on the surface of the earth in the presence of men and animals, perhaps attached more or less to the surface of all objects, but especially to all found within human habitations, and, we might almost add with equal certainty, the habitations of all animals.

It is probable that the chief cause of the presence of ammonia on surfaces in houses and near habitations is the direct decomposition of organic matter on the spot. If so, being more readily observed than organic matter itself, it may be taken as a test, and the amount will be a measure of the impurity. A room that has a smell indicating recent residence will, in a certain time, have its objects covered with organic matter, and this will be indicated by ammonia on the surface of objects.

The air of towns is filled with ammonia, as the result of the concentration of a large population on a limited area. In such localities the air is filled with the impurities which it is the practice to retain in and about the houses, on the street surfaces, and often on open spaces within and around the city area. It frequently happens that the whole subsoil of a town becomes saturated with impurities from carelessness in removing filth, and then that it gives out dangerous emanations.

In many Indian cities nitre is obtained from the subsoil which results from the soil having been long used as a deposit for excreta. The whole subsoil of our cities used to be perforated with cesspits, which were generally porous, and were preferred to be so, because it rendered frequent emptyings unnecessary. The experience of Munich is most instructive on this question. In that city, the enteric fever mortality per 1,000,000 of inhabitants, for quinquennial periods was as follows :—

From 1854 to 1859, when there were absolutely no regulations for keeping the soil clean, and cesspits were porous	24·2
From 1860 to 1865, when reforms were begun by cementing the bottoms and sides of porous cesspits	16·8
From 1866 to 1873, when there was partial sewerage	13·3
From 1876 to 1880, when the sewerage was complete	8·7

This contamination of the air is specially important in old cities, in which the houses are so built together that the vast ocean of air with which we are surrounded cannot get at and through the houses to purify them, as it does in the houses in the country.

The mud from a paved street in London was found on analysis to contain nearly 90 per cent. of horses' dung.

Each year the description of pavement in London is being improved, and the area of paving, in some form or other, is being extended; but even with the most improved forms of pavement the air is filled with dust. If the dust which lies all about the wood pavements be examined, it will be seen to consist largely of horse-dung, and town air is thus full of ammonia. Nor can we hope to get rid of this impurity until asphalte or wood pavements, combined with steam or electric propulsion for vehicles, become universal in our towns.

In this country another chief cause of impurity in town air is smoke.

In proportion, therefore, as towns increase, so do the causes which injure the purity of the air increase. In this respect the conditions under which we live are rapidly altering.

The whole tendency of the present age in England is to agglomerate populations in large towns.

The size of London has always been spoken of as abnormal, but, since the beginning of the present century, London has increased regularly at the rate of about one-fifth in every ten years, at which rate the population will not fall very far short of 6 millions in the year 1900; and other towns, if they do not contain an abnormally large population within their municipal boundaries, at least have an enormous inhabited area around them.

The methods by which the majority of the population obtain warmth remain almost as rude as they were in early times, and the concentration in towns of large numbers of smoky fires for domestic warming destroys the purity of the air.

There are few things more picturesque than on a bright calm autumn day, when the sunshine is modified by a haze, to come in sight of a cottage situated near a wooded hill, from whose chimney a thin column of smoke rises straight up into the air. The smoke from this single fire does not dissipate itself rapidly; it hangs about in the haze in curling masses, and adds to the picturesqueness of the scene. When, however, we aggregate together cottages and houses into a vast town, the smoke which we admired and loved to see hanging about whilst it proceeded from one fire, becomes from its persistence a source of trouble and evil.

The oppressive character of London air is probably largely due to the enormous consumption of coal. The presence of sulphuric acid in London air is very noteworthy. Numerous analyses of various sorts of coal have showed that, whilst there was a mean of 1·7 per cent. of sulphur in these several coals, no more than 0·2 per cent. remained in the ash. Therefore the burning of 1000 tons of these coals sends 15 tons of sulphur into the air as sulphurous acid, and this soon becomes converted into sulphuric acid;

this is sufficient in quantity to render the rain-water which is collected in towns very frequently acid. The quantity of coal estimated to be consumed annually in the districts in and around London may be put at 7,500,000 tons, and London air contains about 19 grains of sulphurous acid in a cubic yard of air. It has been sometimes contended that this class of impurity may have some neutralising effect on the large amount of organic matter which is present in London air, and which arises from the other causes of impurity already alluded to. However this may be, the same argument cannot be advanced in support of retaining in London air an enormous quantity of soot, fine carbon, and tarry particles of coal, which is given off in combustion, and which has been estimated to amount to nearly 1 per cent.

In an article in the 'Quarterly Review,' in 1866, Dr. Percy said : " In London we breathe coal smoke, our buildings are made hideous by coal smoke, and not only do our hands and faces contract dirt, but soot finds its way to our lungs. Plants struggle for existence in the London parks. If our windows are opened, smuts penetrate into our rooms ; if we trust to ventilating openings, the incoming air is so loaded with soot that it blackens everything in the vicinity of the aperture." This was the condition of things in 1866 ; it is worse now. More recent investigations into the causes of fogs emphasize the evils of smoke.

Dr. Aitken, of Edinburgh, has explained the causes of fogs. Fog appears to be formed by the condensation of the aqueous vapour in the atmosphere upon any solid nuclei which may be at hand. The formation of fog, therefore, depends in the first place upon the presence of aqueous vapour, and in the next place upon the dust particles in the atmosphere. If there were no dust, there would be no fog or rain, but the aqueous vapour would condense upon the trees or houses or our clothes. But the action of dust in producing fog varies with different conditions. Sometimes the condensed vapour takes the form of a fog so fine that it easily floats in the air and never seems to settle. In another case the cloudiness is coarser-grained, and settles down slowly; and in another case, it is a very coarse-grained mist or rain which falls quickly.

When the dust is present in large quantities, the condensed vapour forms a fog, because, as there are a great number of dust-nuclei, each nucleus only gets a very little vapour, and is not made much greater or heavier, so it continues to float in the air.

As the number of dust-nuclei diminish, the amount of vapour condensed on each particle increases; their size and weight therefore also increase, so that, as the density of the cloudiness decreases, the size of the particles increases, and their tendency to settle down also increases.

Fogs will, therefore, only be produced when there is abundance of dust-nuclei and plenty of vapour. Some kinds of dust seem to form better nuclei than others, such as salt, of which the air is always very full, from the sea-spray.

Ammonia and the products of combustion of the sulphur in coal appears to have a similar affinity for vapour.

It is thus evident that all fires, however perfect the combustion, are fog-producers when accompanied by certain conditions of moisture and temperature, and that combustion, under all conditions, is bad as a fog-producer: bad, whether the combustion be perfect, as in a Bunsen flame and a clear fire, or imperfect, as in a smoky flame and smoky fire.

It is, therefore, hopeless to expect that by adopting fires having a perfect combustion—such as gas fires, now so much advocated—we would thereby diminish the fogs which at present, under certain conditions, envelop our towns, and give rise to so much that is both disagreeable and detrimental.

But the soot adds to the blackness of the fogs, and if we diminish the amount of black smoke, we shall at least remove some of the most unpleasant conditions of London fogs.

The tarry matter from the coal also adds to the persistency of fog. Thus, if the fog were pure—that is to say, were a true fog, and nothing but a fog, such as one sees in the country—it would dissolve when heated, as every well-conditioned fog does. A fog is never seen inside a country house. But a town fog enters our houses, and carries its murky thickness into our rooms, and will not be induced to make itself invisible, however warmly we treat it. It will on no account dissolve into thin air, however warm our rooms, for the simple reason that heat only dissolves the moisture and leaves the smoke, which constitutes a room fog, to settle slowly, and soil and destroy the furniture.

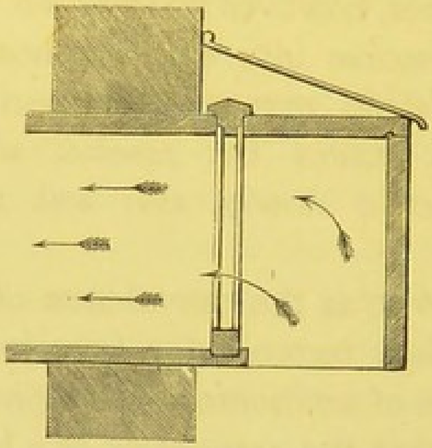
Inasmuch, however, as the prevalence of fogs, especially of that class of fogs termed dry fogs, in towns, is chiefly due to the presence of ammonia and sulphurous acid in the air, it is apparent that the occupation of a locality by a large number of human beings introduces impurities into the air, which we could disregard when the communities are scattered, but which become of paramount importance now that our aggregations of population become so large.

If it were not for the continual movement of the air, dwellers in towns would be asphyxiated by the quantity of their own emanations.

The smoke, by making the town fog more persistent in its character than a country fog, is the cause that a canopy of fog and smoke almost always appears to hang over our large towns, and to be persistent in proportion to their size; and whilst in a town of moderate size the action of the wind will effect a frequent renewal of the air, with the vast extent of London, it requires a very strong wind to do much more than move the persistent canopy which hangs over us from one part of London to another. For these reasons it is necessary to lay great stress on the removal of smoke, which increases the persistency of this canopy; because upon its removal depends the purification of the air of London, and without pure air we cannot ventilate our houses properly. If we are to have pure air in our houses, we must have pure air outside. All our ventilating arrangements will be useless unless we can bring pure air through our ventilators.

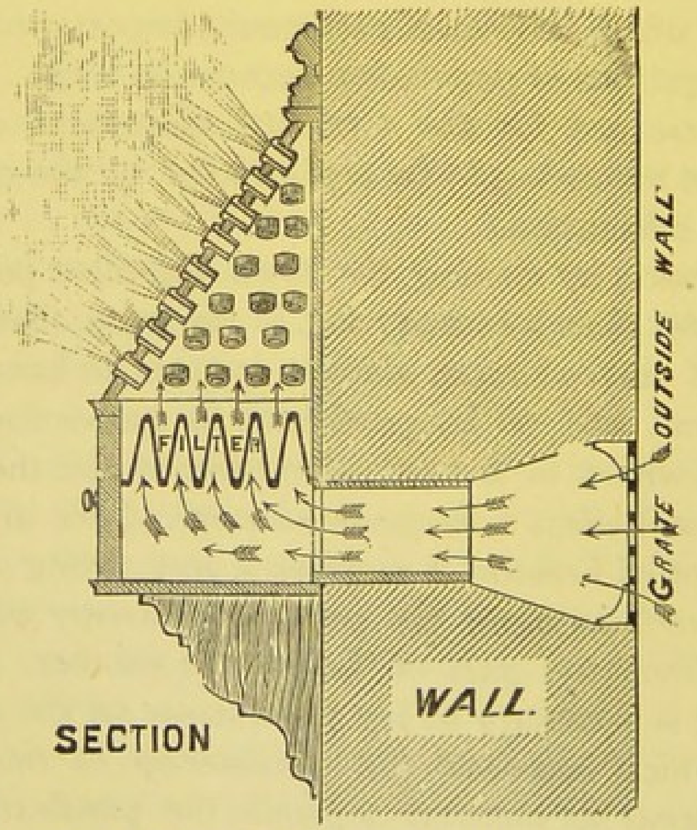
In a town, where the air outside is thus almost necessarily full of impurity, it is desirable to resort to some method of freeing the air from dirt before it passes into the house. A simple strainer of five or six thicknesses of copper gauze would answer fairly well. A filter of cotton wool, Fig. 1, is perhaps the most perfect method of filtering air, but

Fig. 1.



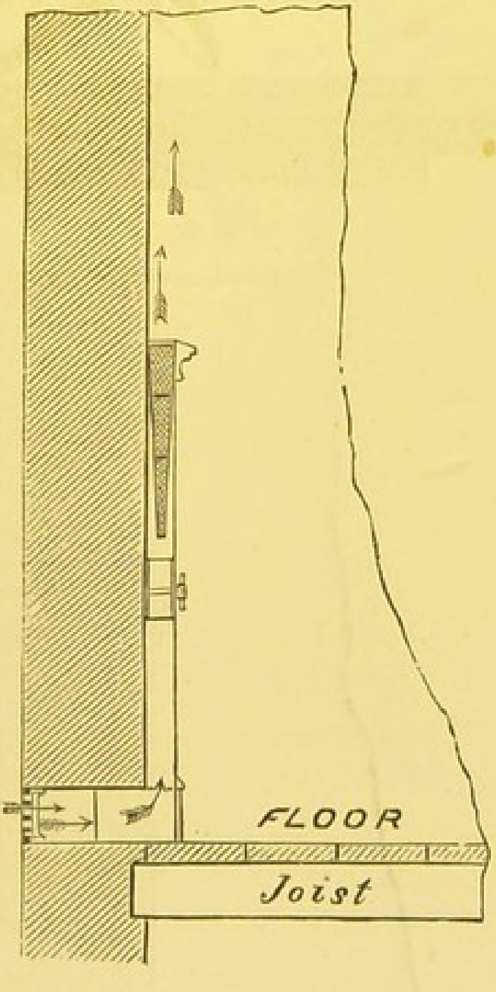
I.—SECTION TO FRESH AIR FLUE WITH COTTON WOOL FILTER.

Fig. 2.



the cotton wool requires to be changed frequently, as in London it soon becomes saturated with soot. Fig. 2 shows a section of Harding's Ventilator in which the air is passed through a screen of bunting. Fig. 3 shows another arrangement, as adopted by the Sanitary Engineering and Ventilation Company. By this method the air is passed through a strainer of rough woollen cloth.

Fig. 3.



In New York, where the dust is very plentiful, the air for the ventilation of the Maddison Avenue Theatre is drawn down from a tower 60 feet high through a long conical sack of woollen material, in which most of the dust is retained.

Another method of purifying air from dust is by means of water. The Sanitary Engineering and Ventilating Company pass the air for ventilation over a surface of water (Figs. 4 and 5).

Fig. 4.

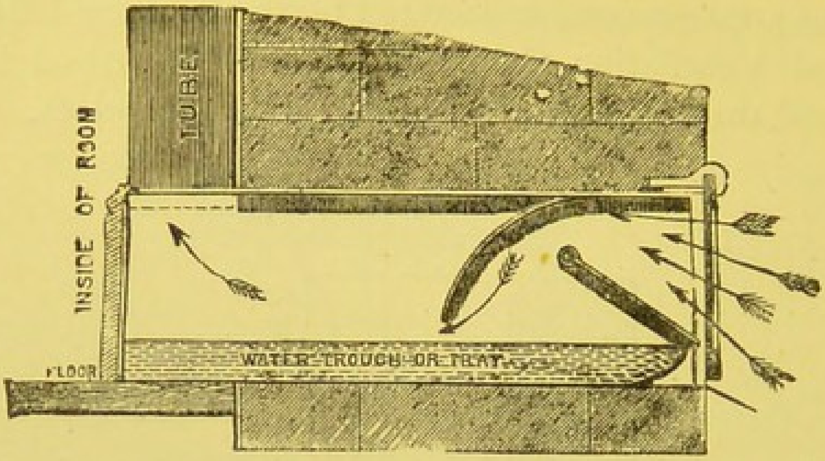
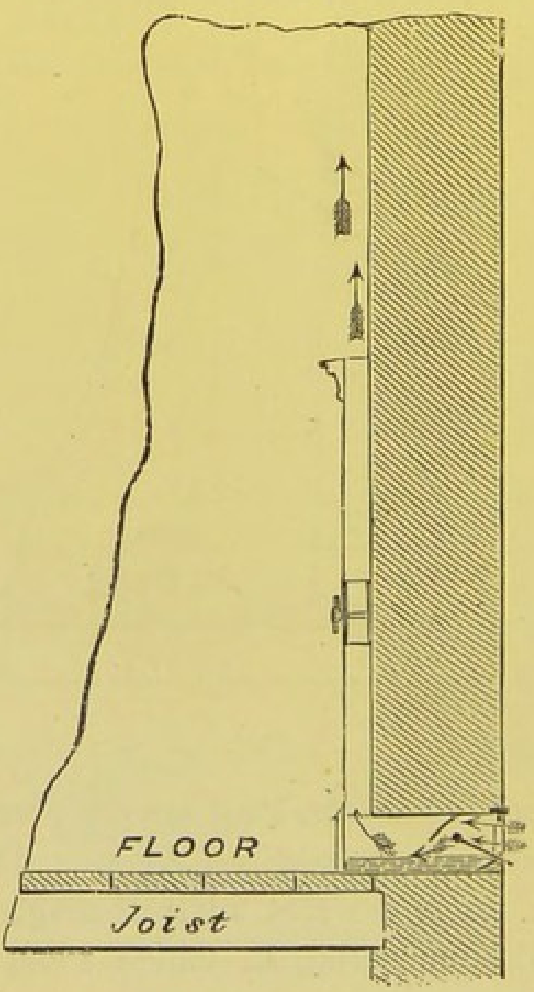

TUBE
INSIDE OF ROOM
FLOOR
WATER TROUGH OR TRAY

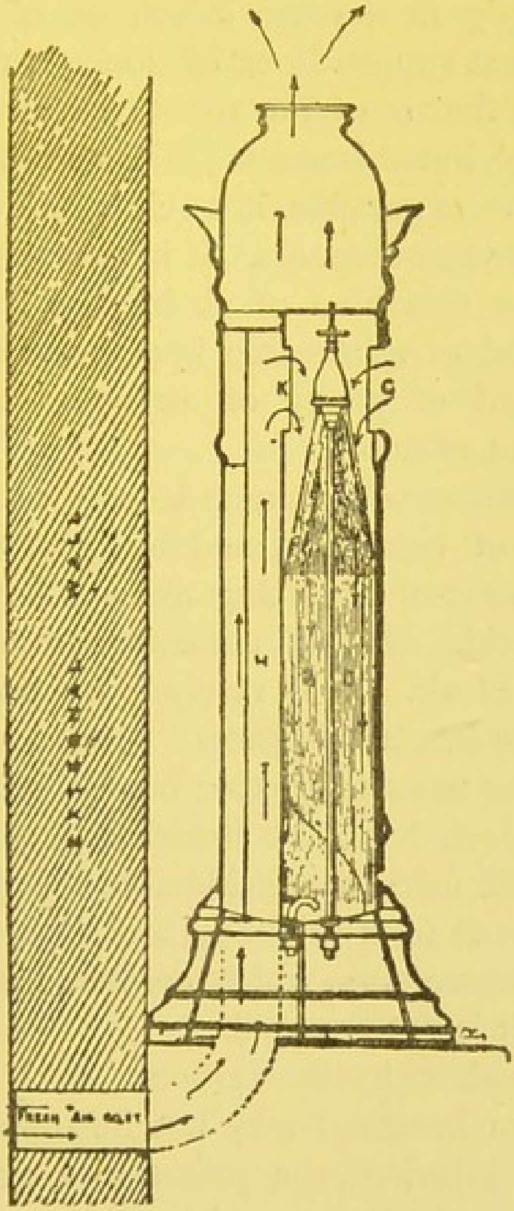
Fig. 5.


FLOOR
Joist

In the Houses of Parliament the air is drawn in through spray, by which it is washed and cooled in summer.

The Œolus Water Spray and Ventilating Company have an arrangement of this description. (Fig. 5.)

Fig. 6.



Having secured the purity of the air drawn from the outside, the object of ventilation is to obtain purity of air inside a building.

The conditions are so different. Wherever there is animal life there are emanations which render the air around impure. Out of doors the movement of the air carries the impurities away. For instance, air out of doors seldom moves at a less rate than 6 feet per second. The average rate of movement in England is about 17 feet per second. It has been calculated that at the lower rate nearly 200,000 cubic feet of air per hour would pass over the space occupied by a human body out of doors. Therefore, if it were desired to supply in a room a volume of fresh air comparable with that supplied out of doors, it would be necessary to change the air of the room from twice to six times in every minute, but this would be a practical impossibility; and even if it were possible, it would entail conditions very disagreeable to the occupants. It is thus evident that when considering the condition of air indoors, it is necessary to seek a standard of admissible impurity in the air rather than a standard of purity of air comparable with that which exists out of doors.

Air, in connection, with human beings, is rendered impure by the action of breathing, and by emanations from the skin, &c. The act of breathing absorbs oxygen and gives out carbonic acid. Normal air contains about 4 parts of CO_2 in 10,000 of air. It is rarely found to exceed treble that quantity in inhabited spaces. Over brewers' vats five or six times that amount is often inhaled with impunity.

But in air which has been breathed there is, in addition to the carbonic acid, a considerable quantity of organic matter thrown out from the body, and it is from this cause that rooms become close which contain many people, and in which the air is not changed.

Therefore, although the carbonic acid present in air which has been breathed may not be sufficient in amount of itself to be injurious, the presence of carbonic acid is a convenient test of the other impurities: and where the amount of carbonic acid present in air which has been breathed is found to exceed from 6 to 8 parts in 10,000, the air is found to be very close.

In addition to the proportion of carbonic acid, and of the impurities of which its presence affords a rough test, there are conditions of temperature and humidity necessary for good ventilation.

Air always contains more or less aqueous vapour, either in an invisible state or in the form of clouds, fogs, and mist. Vapour exists in the atmosphere at all temperatures, even below the freezing point of water. When the temperature of air cannot be diminished without depositing water upon the walls of the containing vessel, or appearing as a mist, it is said to be saturated. If the temperature of saturated air be raised, it will, to the feelings, become drier, and will immediately begin to take up water which is exposed to it. Air is dry or moist, not in proportion to the water it contains, but in proportion as it is more or less removed from the point of saturation.

The point of saturation rises more rapidly than the temperature. A quantity of air absolutely humid at 32° Fahr. holds in solution an amount of vapour equal to $\frac{1}{160}$ part of its weight; at 59°, $\frac{1}{80}$; at 86°, $\frac{1}{40}$; at 113°, $\frac{1}{20}$; and at 140°, $\frac{1}{10}$. Consequently, while the temperature advances in arithmetical progression, the power of the air to retain vapour rises with the accelerating rapidity of a geometrical series having a ratio of two.

When masses of air of different temperatures, each containing its full amount of aqueous vapour mix, the result must be a deposition of moisture.

After continued cold weather, when our houses have been throughout reduced in temperature, and a warm moist wind succeeds, we perceive that moisture collects upon the walls and furniture, or any other cold object; the cause of this deposit is to be found in the fact that the air in immediate contact with these objects is lowered in its temperature, and, being already nearly saturated, all the vapour above that due to this lower temperature immediately appears in the form of minute drops. A glass tumbler filled with cold water, in summer, is soon bedewed with moisture, because the air around it is cooled, and its moisture precipitated upon it; the same would occur in winter if the tumbler were brought into a close room in which many persons were assembled, and the air loaded with the accumulated vapour exhaled from their lungs and skin. From the same cause, the cold windows of a crowded lecture-room in winter, not provided with efficient ventilation, are constantly covered with minute drops of water, which soon collect together, and run down the glass in streams.

The highest point of the thermometer at which vapour begins to be deposited by the air is called the *dew-point;* it is the point at which dew begins to form.

The humidity of the air is practically measured by the difference between the dry-bulb and wet-bulb thermometer.

In order to appreciate the bearing of this on ventilation, it is necessary to consider the relation which the sense of cold, or warmth, bears to definite temperatures with varied proportions of humidity.

The natural heat of the body is being constantly supplied by the agency of the food and air we consume, and depends upon a constant loss of heat from the person, which has been calculated at from 3½ to nearly 6 units of heat per minute, the unit of heat being equal to one pound of water heated 1° Fahr.

The internal warmth of the body is 98° Fahr., and the feeling of comfort, which is experienced under certain conditions of the atmosphere, proceeds from the way in which the temperature and humidity regulate the cooling of the body. The heat generated in the body is lost partly in the air expelled by the breath, partly by evaporation of moisture from the skin, partly by conduction, and partly by radiation.

A moist atmosphere will check the insensible perspiration, but it will assist the loss of heat by conduction. A saturated atmosphere at from 35° to 40° Fahr. will be found to be intolerably chilly ; and although the evaporation may be checked, and this source of loss of heat removed, yet the conduction and radiation due to the vapour in the air will be enormously increased. For instance, a Scotch mist of 36° Fahr. (which is only supersaturated with vapour in excess at a slightly higher temperature than the air) penetrates clothing, and reaches every part of the person with penetrating cold. Whilst on the other hand, a temperature of 50° to 65° in a nearly saturated atmosphere seems to provide an equilibrium between the cooling action by conduction and radiation, due to the vapour in the air and the supply of heat from the checked evaporation from the skin, so that such an atmosphere is not uncomfortable, and is favourable to mental and physical exercise.

A temperature of from 65° to 80° Fahr., with a saturated atmosphere, becomes sultry and oppressive. The surplus heat cannot be removed by conduction or radiation, and the natural effort of the system is to produce evaporation. The least physical effort induces perspiration. The lassitude and enervation produced is unfavourable to mental and physical labour.

Above 80° Fahr. a saturated air becomes most oppressive, and it is questionable whether life could be prolonged in a saturated atmosphere of 90° or 100°.

Every man gives off from the lungs and skin each hour enough to raise the humidity from 70 per cent. to complete saturation in 500 cubic feet of air at 60° Fahr., and to raise it to 82 per cent. in 1500 cubic feet. Now, to reduce this amount to 75 per cent. would take 3000 cubic feet of air saturated at 50° Fahr., or 2000 at 98 per cent. But the vapour given off by the body is not the only source of humidity. Humidity may arise from the vapour of liquids used in the room, or from the combustion of lights.

According to theoretical calculations, it would appear that, with an initial air-space of 1000 cubic feet, occupied by one individual, it would be necessary to supply 3000 cubic feet per hour to maintain the room in a proper condition of humidity. As regards other impurities, if 0·2 per 1000 of CO_2 are accepted as the limit of respiratory impurity in a well-ventilated air-space, in addition to the 0·4 per 1000 in normal air, we can calculate out the amount of air necessary to maintain this proportion constantly; and from this calculation it appears that it requires 3000 cubic feet per hour to preserve the air-space in the required state of freshness.

Thus the theoretical calculations, based first upon humidity, and secondly on carbonic acid, bring us to similar conclusions in each case.

But in practice the conditions of ventilation are affected by difference of site or of exposure, as well as by the arrangement, the material, and the mode of construction of buildings. Some of the difficulties which have arisen in solving problems of ventilation arise from the want of consideration given to these collateral circumstances. And from a careful practical examination of the condition of barrack-rooms and hospitals in this country, made by the Barrack and Hospital Commission in 1857–58–59, in which the degree of impurity of the air was tested mainly by the sense of smell, it appeared that arrangements which appear to provide for a volume of air much less in amount than that obtained by calculation will keep the barrack-rooms in a fair condition. These results have pointed to about 1200 cubic feet of air per hour with 600 cubic feet of space. This need not be set down to errors in calculation or in theory. The conditions under which the air flows in and out of a room are so varied. The walls and ceiling themselves allow of a considerable passage of air, and especially unplastered walls, such as are in use in many barrack-rooms.

A room with several of its walls exposed to the outer air would probably obtain more renewal of air by this means alone than a room with only one outside wall.

Ill-fitting doors and windows allow of the passage of a considerable quantity of air. And in a temperate climate, where the changes of temperature of the outer air are rapid and considerable, especially at night, these means of producing the outflow from and the inflow of air into a confined space are in constant operation. A sleeping-room is very warm at bed-time ; a rapid fall of temperature outside occurs, and at once a considerable movement of air takes place.

The majority of occupiers of sleeping-rooms in England close their windows at night ; they often block up the chimney by a register or otherwise, to prevent the "blacks" falling. They have no special inlet or outlet for changing the air, and if it were not for the continual insensible change of air which passes through the walls, doors, and window-chinks, &c., the occupants would be asphyxiated.

In considering the question of ventilation, it is generally assumed that the impurities thrown out by breathing diffuse themselves uniformly through the air of a room. This is not strictly true. But upon this assumption, the degree of purity or impurity of air which is fixed as a standard, ultimately in no way depends on the size of the room, but solely on these two things :—

(*a.*) The rate at which emanations are produced.

(*b.*) The rate at which fresh air is admitted.

The advantage of large space arises partly from the fact that the large room is longer in reaching the state of normal impurity than the small room. For instance, the following table shows the time required to bring air to the standard of admissible impurity—viz. 0·2 per 1000 of CO_2 in different sized rooms, in which all change of air is carefully prevented :—

	Hr.	Min.	Sec.
One man in 10,000 cubic feet	3	20	0
" " 5,000 " "	1	40	0
" " 1,000 " "	0	20	0
" " 600 " "	0	12	0
" " 200 " "	0	4	0
" " 50 " "	0	1	0
" " 30 " "	0	0	36

There is also the consideration that the inflow and outflow of air necessary to maintain the standard of impurity is less perceptible in a large than in a small room, for the chief difficulty of ventilation arises from the draughts it causes. Every one is professedly anxious for ventilation, but no one likes the fresh air to be admitted where it will impinge on them. There is, moreover, in practice, this advantage in the larger rooms, viz. that the larger wall-surface and the more numerous windows will allow of a larger passage of air through them, or insensible ventilation ; and thus, with equal facilities for ventilation, large rooms will have an apparently less degree of impurity than small rooms.

Although the uniform diffusion of carbonic acid is very rapid in the air of a room, the organic emanations given out do not in practice diffuse themselves either rapidly or uniformly. They hang about in corners where there are obstructions to the flow of air, or near the ceiling. On this account efficient ventilation requires that there should be some space between the occupants of a room.

In living-rooms, however, the space between the occupants does not require so much consideration as in bedrooms, because a certain space is necessary for moving about and for furniture ; but in bedrooms, and especially in nurseries or in rooms of that nature, occupied by more than one person, the question becomes of much greater importance.

For purposes of ventilation, the height must bear some relation to the size. Adequate movement in the currents of air cannot be secured in a room unless the height be proportioned to the width and length. The minimum height must be fixed with reference to that which will allow the currents of air to circulate without being inconvenient to the occupants. Therefore, in proportion as the width and length of a room are increased, so must the height be increased.

On this account it is not advisable to make rooms much less than 10 feet high. With large rooms, as the height should be increased in proportion to the size, if the cubic space be the measure of the number of occupants, the area or floor-space per occupant would diminish with the size of the room.

As, therefore, the height of rooms is necessarily variable, it follows that it is rather the floor-space which must be considered in allotting accommodation to the occupants of a room than the cubic space.

In barracks a floor-space of from 50 to 60, and occasionally 80, square feet is allowed per occupant. These are for rooms occupied by day as well as for sleeping-rooms.

In workhouses, for dormitories, a minimum floor-space of 25 square feet has been admitted, provided the ventilation was carefully attended to. In nurseries and servants' rooms, from 50 to 60 square feet is desirable per occupant. That is to say, a room 10 feet square, or 10 feet by 12 feet in area, should not contain more than two persons. In schoolrooms which are only occupied during parts of a day, and where the air can be changed between the periods of occupation, a less amount would suffice, and from 15 to 20 square feet is sufficient.

2. *Movement of Air.*—The quantity of fresh air which it has been considered necessary in this climate to supply for each occupant of a room was laid down by the Barrack and Hospital Improvement Commission at 1200 cubic feet per hour. This amount, with a cubic space per occupant of 600 cubic feet, allowed of the air of a room being changed twice in an hour. If the same inflow of air in proportion to the cubic space be supplied in hospitals, it would afford in the military hospitals nearly 2500 cubic feet per occupant per hour, and in most civil hospitals nearly 3100 cubic feet per hour. Where rooms are more crowded, and the cubic space per individual consequently less, the quantity of air in proportion to cubic space should be increased. Thus, in a schoolroom where frequently not more than 200 cubic feet is allowed per occupant, which is a very unsatisfactory amount, the air of the room ought to be changed five times at least in an hour, if the room is continuously occupied for several hours. If, on the other hand, there are periods of intermission of occupation—that is to say, if the room is free after an hour's lesson, and the air is renewed so as to become fresh before the next lesson—a smaller rate of renewal during the limited occupation would suffice.

The comfort of ventilation depends upon letting the air flow into a room at such a temperature, with such a velocity, and in such a position as will prevent the inmates from feeling any sensation of cold or draught.

The velocity of the air as it flows in and out of a room, as measured at the openings for admission or exit, should not exceed one foot, or at most two feet, per second; first, in order to prevent a sensible draught being felt, and second, because a low velocity is favourable to the uniform diffusion of the incoming air through the air of the room.

To avoid friction, it is convenient that the velocity in the channels leading to the main extracting shafts should not exceed 3 feet to 4½ feet per second, and the velocity in the larger main extracting shafts themselves should not exceed from six to seven feet per second.

These velocities would be regulated by the size given to the inlets, outlets, supply channels, and extracting shafts, as compared with each other respectively, and with the quantity of air to be supplied and removed; which quantity would depend upon the number of occupants of the rooms to be provided for, and the amount of air to be allotted to each, and upon the number of lights burning, and other special causes of impurity in the air.

As a rule, it may be roughly assumed that each candle or gas-light burning 4 or 5 cubic feet per hour will consume as much air as a man.

In order to obtain the movement of air necessary to ventilation, various methods may be resorted to:—

(1.) By taking advantage of the ordinary currents of the atmosphere.

(2.) By supplementing the effect of the ordinary current by the generation of heat in flues or chimneys, so as to cause movement.

(3.) By direct propulsion of the air by fans or pumps, either to draw it into extraction-shafts or to force it into the room.

The movement of air by the two first of the above methods is dependent upon temperature, and all ventilation is intimately connected with difference of temperature. Hence, ventilation and warming must always go hand-in-hand.

The positions of inlets and outlets are matters of important consideration.

Air should be introduced and removed at those parts of the room where it would not cause a sensible draught. Air flowing against the body, at, or even somewhat above, the temperature of the air of a room, will cause an inconvenient draught, from the fact that, as it removes the moisture of the body, it causes evaporation or a sensation of cold.

Air should never, as a rule, be introduced at or close to the floor-level. The openings would be liable to be fouled with sweepings and dirt. The air, unless very much above the temperature of the air of the room, would produce a sensation of cold to the feet. It may be regarded as an axiom in ventilation and warming, that the feet should be kept warm and the head be kept cool.

The orifices at which air is admitted should be above the level of the heads of persons occupying the room; the current of inflowing air should be directed towards the ceiling, and should either be as much sub-divided as possible by means of numerous orifices, or be admitted through conical openings, with the smaller openings towards the outer air, and the larger openings towards the room, by which means the air of the entering current is very rapidly dispersed.

Air admitted near the ceiling very soon ceases to exist as a distinct current, and will be found at a very short distance from the inlet to have mingled with the general mass of the air, and to have attained the temperature of the room, partly owing to the larger mass of air in the room, with which the inflowing current mingles, partly to the action of gravity, in cases where the inflowing air is colder than the air in the room.

The simplest way of obtaining a change of air in a room is to take advantage of the movement of the air produced by differences of temperature, or by the action of the winds.

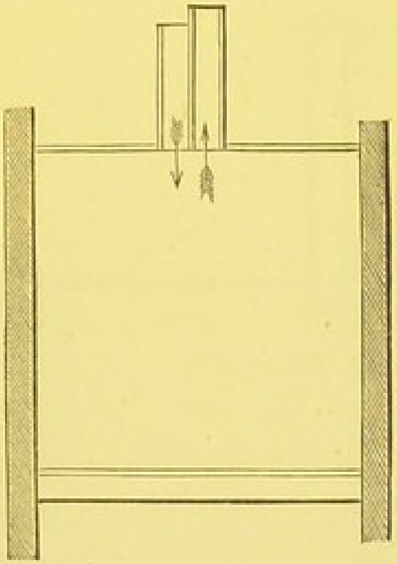
In every room in which there is an opening at the upper part, out of which the warmed air can pass, and an opening either level with it or below it, through which fresh air can flow in, the system of ventilation by difference of temperature will operate.

An ordinary sash-window is the simplest example. If the top sash be lowered and the bottom sash raised, the warmed air passes out of the room at the top, and the cooler outer air flows in below. Hence, for an inlet for air to an ordinary room, provided with a fireplace, but unprovided with special inlets, a very simple plan is to cut a slit along the lower bar of the upper sash of a window, so as to leave a clear space of about a quarter of an inch along its whole length, through which the fresh air will be drawn in in an upward direction. Or a piece of wood may be fitted to the bottom of the lower sash, so as to increase its depth and prevent its closing completely, thus leaving a permanent opening at the junction between the upper and lower sashes, without leaving any room for admission of air and draught at the bottom of the lower sash. The panes of windows are sometimes used for openings for air. One method is simply to cut holes in the pane of glass, and to fix another piece of glass on the pane, arranged on the principle of the hit-and-miss ventilator, by which the openings can be closed or opened at will. These are subject to the inconvenience of allowing a direct inflow of air, and consequent draught. In cottages there is often seen a tin whirligig inserted instead of a pane; this revolves with the admission of air, and breaks up and throws the current towards the ceiling. In window-panes the best forms of ventilators are those which direct the current of air towards the ceiling, such as hopper-ventilators, or Moore's louvred panes.

These are makeshifts; and adequate ventilation can only be obtained by movement of the air through openings independent of windows and adapted to ventilation only.

All arrangements for ventilation are based upon the initial principle that there must be an outlet to remove the vitiated air, and an inlet to admit the fresh air. The various inventions which have been designed to effect this vary chiefly in their efforts to avoid draught. In a closed space, such as a hall, church, or chapel, when the doors and windows are kept closed, the double current may be obtained by Watson's Ventilator, which consists of a large tube carried up from the ceiling to above the roof; the tube is divided vertically down the middle by a partition, so that the heated air ascends one side and fresh air descends the other division (Fig. 7). This action goes on so long as there is no other inlet for the admission of fresh air; but if a door or window is opened, then the opening acts as a subsidiary inlet, and both parts of the tube become outlets. In ordinary buildings, where there are doors and windows liable to be opened continually and fireplaces are in constant action, and where it is convenient that each room should be self-contained and independent of other parts of the building in respect of its ventilation, the system of ventilation adopted in barracks and military hospitals is the most convenient.

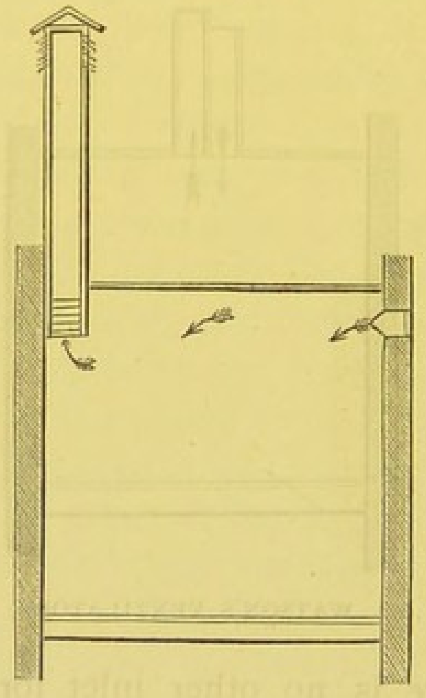
Fig. 7.



WATSON'S VENTILATOR.

This plan consists of an open tube or shaft carried up from the ceiling of the room to above the roof, where the top is exposed to the free movement of the atmosphere. An upward current prevails in the shaft so long as there is a movement in the atmosphere, because the atmospheric current, in its passage over the top of the tube, relieves to a certain extent the pressure which prevails when the atmosphere is at rest, and thus causes the air in the tube to rise. The movement is, of course, unequal in its action. It is powerful when the wind is high. In calm weather it is very small; but in this country, as already mentioned, the average velocity of the atmosphere is above 17 feet per second, and it is rarely quite at rest.

Fig. 8.



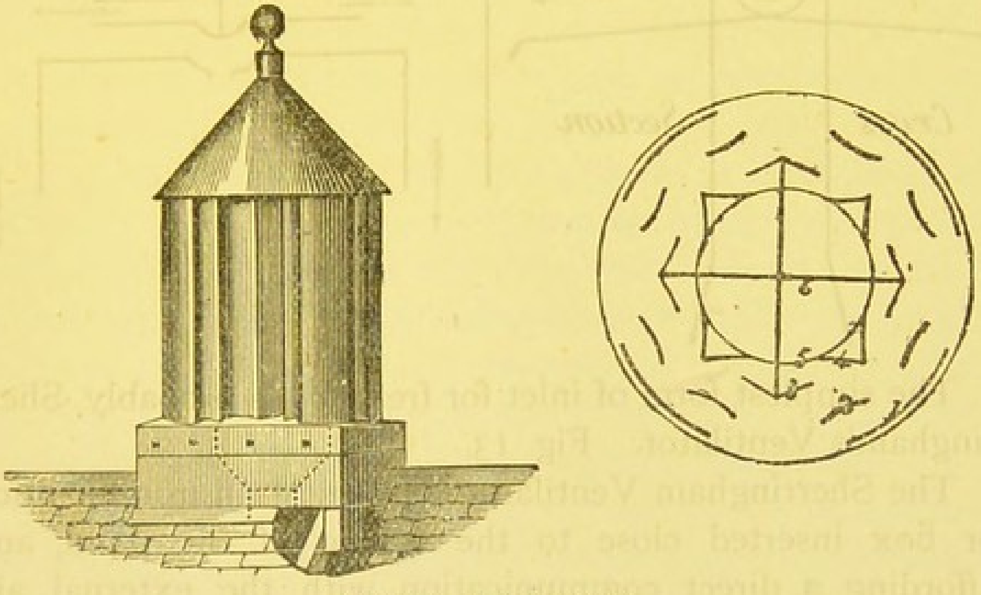
The action of wind, whilst it tends to exhaust the air through the tube, is at the same time acting on all other openings in the building, either to exhaust or to force in air. Hence gusts of wind will sometimes cause a reverse action in the tube, in consequence of some other opening acting temporarily as a means of extraction.

Moreover, if the top of the tube or shaft is in a locality surrounded by higher buildings, currents of air may be directed so as to strike on the top of the tube and thus check the action. Where the top is exposed to the freer action of the wind it will be found that a tube with an open top probably is as efficient as any other form; but the top cannot be left open in all cases, it must be protected from rain, &c., and various forms of cowls have been invented, both to cover the top as well as to prevent down-draught. Mr. Boyle, Mr. Banner, Mr. Buchan, Mr. Stevens, Mr. Hellyer, and the Æolus Ventilating Company, as well as numerous other persons, have all designed cowls with this object.

The annexed sketches show some of these terminals to exhaust flues.

Figs. 9 and 10 show an elevation and plan of Boyle's Ventilator, for which it is claimed that any current impinging upon it necessarily produces an exhaust in the vertical tube.

Figs. 9, 10.

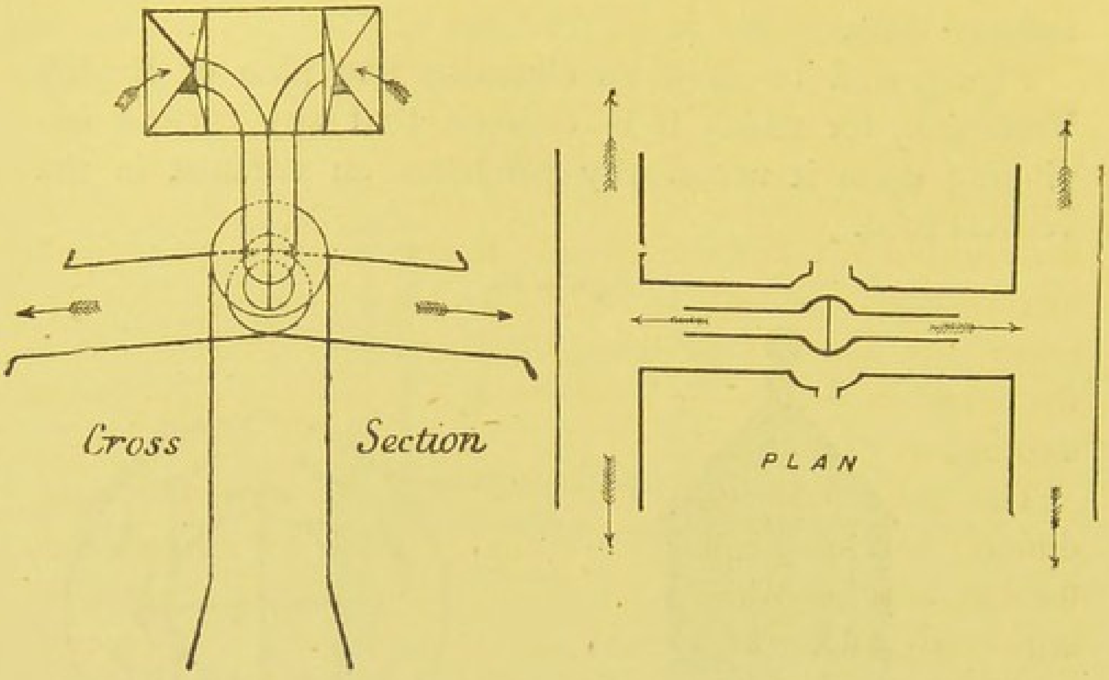


BOYLE'S VENTILATOR.

Figs. 11 and 12 show the Œolus roof ventilator, the action of which is more complicated. It is claimed for this that the current of air which strikes the upper openings is deflected, so as to pass along and out of the horizontal tubes, and thus induce an exhaust in the vertical tube connected with the interior of the building.

In all cases of the use of vertical flues for ventilation, if the atmosphere should be without perceptible movement in cold weather, when the temperature indoors is maintained for comfort above that out of doors, the difference of temperature will cause an upward movement in the shaft. In hot weather, if the shaft is colder than the outer air, a down-current may ensue; but if, in hot weather, there should be little or no movement in the shaft, this occurs at a time when the windows can be kept open, and the air be renewed by this means.

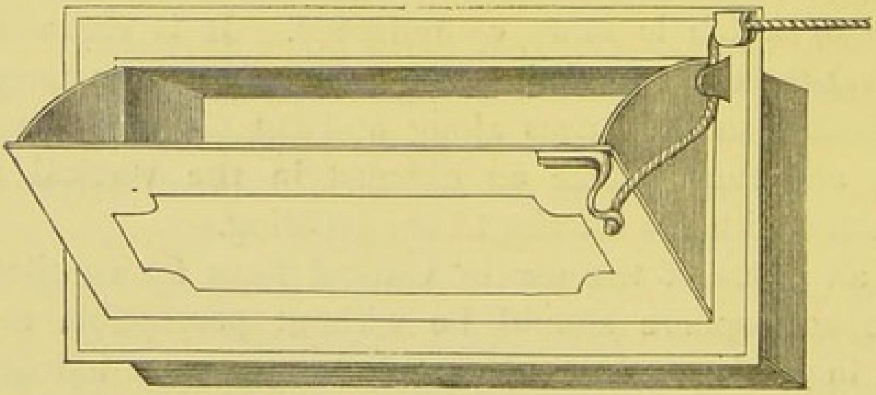
Figs. 11, 12.



The simplest form of inlet for fresh air is probably Sherringham's Ventilator. Fig. 13.

The Sherringham Ventilator consists of an iron air-brick or box inserted close to the ceiling of the room, and affording a direct communication with the external air.

Fig. 13.



SHERRINGHAM'S VENTILATOR.

The current of inflowing air is directed by the hopper form of the valve upwards towards the ceiling. The inside area is larger than the outside area, in consequence of the latter being closed with a grating, and thus the air enters the room at a less velocity than that at which it passes the outer surface of the wall.

Inlets may also be formed by vertical tubes, the opening to the outer air being made near the floor, and the tube being employed as a means of carrying the opening through which the air is allowed to enter the room to a height of five or six feet or more above the floor. This is convenient in cases where necessities of construction make it desirable to place the opening to the outer air low down, as compared with the point of entrance of the air into the room; or when it is desired to introduce fresh air into the centre of very wide rooms or halls without causing an unpleasant draught against the feet.

The main objection to these tubes is that they are difficult to clean, and hence they may become receptacles for dirt, insects, cobwebs, and dust, which after a time may injuriously affect the air passing through them. Moreover, inlets of this shape do not readily lend themselves to act the part of outlets when occasion requires, which is so convenient a feature of the Sherringham Ventilator.

These methods of ventilation depend upon the action of the wind. The other methods which employ mechanical force to propel air are, fans or pumps, or else by means of heat acting directly on air in shafts; this method is usually resorted to when the temperature of the building is desired to be maintained above that of the outer air.

In the movement of air by fans or pumps the propulsion is direct; a given weight of air has to be moved a given distance. For instance, the weight of a cubic foot of air is about 1¼ ounces. Therefore, if we assume that a patient in a hospital ward requires 3000 cubic feet per hour, the air which ought to be removed per patient per hour would weigh about 2 cwt., or in 24 hours the weight would amount to nearly 2½ tons. This gives an approximate idea of the daily work necessary to be done in ventilating a hospital ward efficiently.

A rotary fan may be explained as consisting primarily of a certain number of tubular passages, which are rotated about a lineal axis at right angles to the direction of the passages, whereby a given volume of air, impelled either by centrifugal force, or by the shape given to the tubular passages radially, is moved at a determined pressure.

Péclet, in his "*Traité de la Chaleur Considérée dans ses Applications*," says, "It is demonstrable, in mechanics, that if a tube A B, cylindrical, and completely open at its two ends, turns around a line O, perpendicular to its axis, the air escapes by the extremity A of the tube with a velocity equal to the velocity of rotation at this extremity. The velocity of escape is the same whether the tube is more or less long, provided the distance A O remains constant; it is still the same when the tube is curved. If we suppose that the orifice A be closed, in all cases possible, the pressure exerted by the air against the interior surface of the partition (cloison) will be equal to the height of air corresponding to the velocity of rotation of the point A." This is the principle which governs the action of all rotary fans.

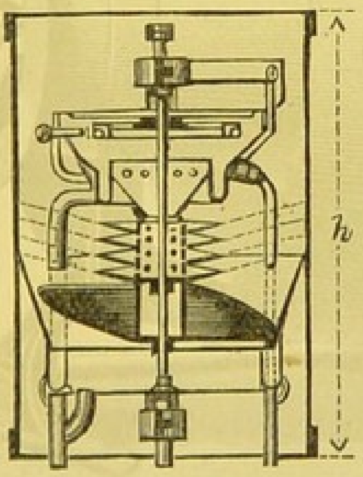
The pressure attainable by any rotary fan is exceedingly low when considered in pounds per square inch. In fact, a pressure or suction of three inches or four inches is nearly as large as can economically be attained in delivering a quantity of air, when the friction of machinery at high velocities, the want of adhesion of belts, and certain other considerations of friction of air on the vanes are accounted for. Thus, the largest differences of pressure by the action of a fan is less than the ordinary atmospheric disturbances, as indicated by the barometer. There are other forms of blowers, such as Root's blowers, for instance, in which the action assimilates more nearly to that of a pump, that is to say, the air is driven forward by the direct action of the pistons.

Fans have been largely resorted to in the United States. Much attention has been there given to the form of fans for domestic and also hospital ventilation. In this country, however, where, as in a hospital, the necessity of ventilation is continuous, the use of fans has not hitherto been largely adopted, but when applied it has been chiefly applied in cases where the necessity for ventilation is intermittent; such, for instance, as in a dining-room, a church, or a room for public meetings. In some cases in workshops, where a considerable and rapid change of air is required at special parts of the room, for removing deleterious products, a fan is of great utility. For the removal of air on a small scale from dining-rooms or smoking-rooms, M. Joly, in Paris, has devised a fan to be worked by hand; and Mr. Verity, in London, has one worked by water-power.

In the International Health Exhibition a fan on a similar principle, termed the "Aërophor," is exhibited by Messrs. Treutler and Schwarz, of Berlin.

The "Aërophor" is driven by water-pressure from pipes, or by a pump, or by steam, and acts either as an air-propeller for introducing air, or as an air-sucker for removing air. (Fig. 14.)

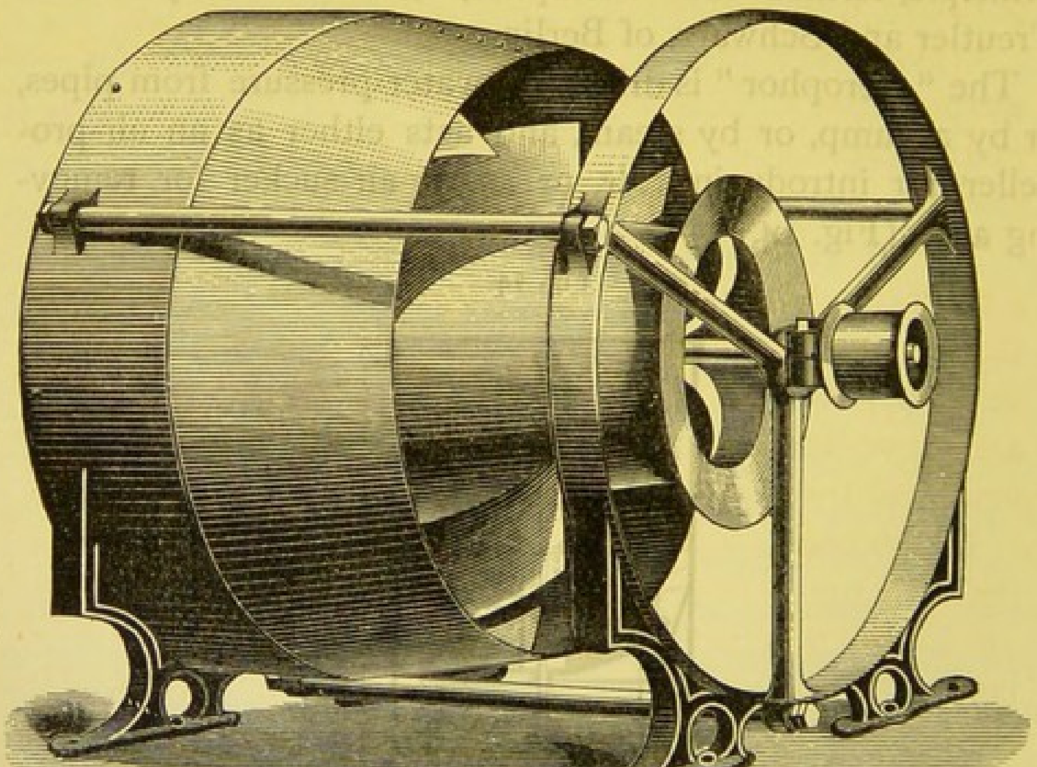
Fig. 14.



The apparatus consists of—1st, a cylindrical case; 2nd, the driving-wheel, which in form is a toothed wheel; and 3rd, the ventilator, which is connected directly with the axle of the driving-wheel. On the axle is a contrivance, termed the Pulsion apparatus, for producing spray from the water already used in driving the apparatus, which frees the air from dust, and also moistens and tempers it. The water, or where steam is used the steam, issues through a number of jet-pipes placed on the circumference of the driving-wheel; and, by acting on each of the teeth in succession, gives to the driving-wheel a very swift rotating motion which is communicated to the ventilator by means of the axle.

Another fan is exhibited by J. M. Lamb and Co. in the International Health Exhibition, which is stated to be of a new form and arranged to be driven by steam or any other power. It is shown in Fig. 15. Of the relative powers of these fans no data have been supplied.

Fig. 15.



3. *Warming of Air.*—Heat is the principal agent in nature by means of which movement of air is produced.

The molecules of air are but feebly attracted to each other, and small increases of temperature or slight diminutions of pressure separate the particles from one another, and thus one cubic foot of expanded air weighs less than a cubic foot of normal air. Similarly, small decreases of temperature bring the particles nearly together, and make the cubic foot of cold air heavier than the standard above mentioned. A cubic foot of dry air at a temperature of 32° Fahrenheit weighs 566·85 grains; and a cubic foot of dry air at a temperature of 100° Fahrenheit weighs 497·93 grains. This expansion and contraction are equal for equal increments or decrements of temperature.

The expanded or lighter air moves up, and its place is filled by cooler, and therefore heavier, air, which takes its place. Hence, the upward movement of air depends upon its expansion by heat, because changes of density in the atmosphere produce an immediate motion of the heavier portions in their relation to the lighter.

When, as in winter, the air in a room or chimney is warmer than the outside air, an upward current takes place in the chimney. When, in summer, a chimney is colder than the outside air, a downward current takes place.

The velocity of the upward movement of heated air in a shaft depends upon the difference of temperature between the air in the shaft and that of the outer air, and consequently the volume of air which will be removed by a shaft or flue depends upon the area of the flue and the height of the flue.

In the ordinary chimney flue of a room with a bright fire the velocity of the ascending gases will often attain from 15 to 20, and even more, feet per second. The flue being 9 in. by 14 in. diameter, the flue would remove 45,000 to 60,000 cubic feet per hour, or from 40 to 50 tons of air in 24 hours.

Heat is the equivalent of a given amount of work; thus friction, or concussion, or compression, produce heat. Heat is also produced by chemical action, as for instance in the case of the union of the carbon in coal with the oxygen in the air.

Heat is transferred from one body to another, or from one place to another, by conduction, convection, and radiation.

In this country our houses are all warmed by heat derived from coal or the products of coal, such as coke or gas. The usual plan is to use raw coal; and, with all its imperfections, it is on the whole the cheapest and most convenient form of obtaining heat. There are, however, numerous objections to its use. It creates dirt and dust in a room; it sends up smoke and soot into the atmosphere; and, as we have already mentioned, makes our town fogs blacker and more persistent. Coke is free from some of these imperfections, and gas would be an eminently clean fuel.

Gas made for illuminating purposes is, however, too expensive for a fuel. At 4*s.* per thousand cubic feet, it may be assumed to cost from three to four times as much as coal. But it is quite certain that if gas were made for heating purposes only, and were sold at from 1*s.* 6*d.* to 2*s.* per thousand cubic feet, the use of gas would obtain a very great extension, because it can be applied so conveniently and easily.

The oxygen required for combustion is supplied by air.

The nitrogen of the air passes through a fire without material alteration, and for purposes of combustion the oxygen alone is available. The nitrogen is indeed a source of loss, because it has to be warmed in order to be carried up the chimney.

The air which has passed through a fire retains a considerable proportion of its normal quantity of oxygen, and therefore, for practical purposes of combustion, the supply of air should be increased beyond the quantity which theoretical considerations show to be necessary in the ratio of $1\frac{1}{2}$ to 1 or 2 to 1; and it may be assumed that one pound of coal or charcoal requires for its combustion about 300 cubic feet of air at 62° Fahrenheit.

In a close stove perfect combustion depends on the proportions which the area of the grate and other apertures for admitting air bear to the amount and nature of the fuel used, to the height of the chimney or other means for drawing or propelling the air through the fuel, and to the power of regulating the inflow of air by dampers or doors. In open fireplaces, whilst a blazing fire will be best obtained by a grating under the fire, yet if the air be properly guided to the back as well as to the front and sides of the upper part of the fuel a bright fire may be obtained with a solid bottom. In all cases, when the supply of air is insufficient, carbonic oxide is formed ; which may be seen by a blue-coloured flame.

The heat evolved in forming carbonic oxide is much less than that evolved in the formation of carbonic acid ; therefore it is wasteful to burn coal with an insufficient supply of air, in such a manner as to allow of the formation of carbonic oxide instead of carbonic acid gas.

Smoke is the bane of all our large towns, and has been shown to have an important influence on the persistent character of fogs in large towns.

The primary condition for the prevention of smoke is the complete combustion of the fuel ; to effect this the combustible gases should be intimately mixed with air, and the mixture should be effected at a high temperature. Those grates and stoves which fulfil these conditions in the most perfect way would be those which would not only avoid smoke but would also develop most heat out of the fuel ; and if their parts are properly arranged, they should give out most heat for useful purposes.

Conduction is the transference of heat from one body to another when the whole space between is filled with some medium, of whose existence we are cognisant by our ordinary perceptions, and moreover is a transference by means of that medium.

If a poker be held with the end in the fire, the heat from the fire is transferred along the poker to the hand by conduction.

Convection is the transference of heat from one place to another by the bodily moving of heated substances.

The warming of a building by hot-water pipes is an instance of transference of heat both by conduction and convection. The heat from the fire is in the first place communicated by conduction through the plates of the fire-box, from the incandescent fuel to the water in the boiler. It is transferred by convection along the pipes which convey the water to different parts of the building, as the hot water circulates. It is again transferred by conduction to the air close to the pipes. This air, being expanded, ascends and carries the heat with it by convection to different parts of the room.

Radiation is a form of the transference of heat which is not either conduction or convection by ordinary matter. That is to say, heat which is transmitted in a manner of which all we know for certain is that it is not convection or conduction by ordinary matter, is called Radiant Heat.

In a homogeneous medium radiant heat is propagated in straight lines.

It is propagated with less velocity in a dense medium than in a rare one.

The amount of heat radiated from a body at a given temperature depends on the physical nature of the surface of the body.

If a cube be made of tin and filled with hot water, and one of the sides blacked and another left bright, much more heat will be radiated from the black surface than from the bright one. The hotter the body, the greater proportionately will be the rapidity with which it emits radiant heat.

When radiant heat falls on a surface, part is reflected and part enters the substance, and is either absorbed or continues its course in right lines in a direction inclined at some angle to its former course, according to the nature of the substance, and to the surface and angle at which the heat falls on it. Solid substances which allow radiant heat to pass freely through them in right lines are called diathermous; those that do not adiathermous.

Rock salt is the most diathermous substance known.

Radiant heat thus warms to a greater or less degree the solid bodies upon which the rays impinge, but passes through air without warming it.

These considerations have an important bearing on the warming of our houses, in effecting which object we usually resort to one of three methods :—

1. The open fireplace in each room.

2. Warmed air brought into the rooms or corridors by flues from a centrally-placed calorigen.

3. Close stoves, placed in the room or corridor to be warmed, or else hot-water pipes, or steam pipes, heated by a boiler in some central position and carried by the pipes thence to the places where the heat is wanted.

That the heat conditions which prevail between the air and the walls or objects in a room are different in each of their cases will be apparent from the following considerations :—

Sometimes we attribute to a current of air a sensation of cold which comes from another cause.

We hear often, "I don't like sitting near this window, or close to this wall," and so on; "there is always a slight draught coming from there."

We fancy that we feel in the draught the motion of a wind, but it is mostly the result of a loss of heat from the warm body on one side by radiation towards the adjacent cold surface. People generally imagine in such a case that the wind is passing through the wall. But the velocity of such a wind would be too small to be felt as air in motion, and a piece of carpet fixed to the suspected wall, which checks the radiation of heat from the body to the wall, does away with the supposed draught. In this case the walls of the room are unduly cold as compared with the body of the occupant of the room.

If there is a bright fire in the room, the rays from the flame and incandescent fuel convey warmth to the walls of the room, whilst its rays leave the air to be breathed cool; and there is no doubt that the perfection of ventilation would be to have cool air to breathe, but to be surrounded with warm walls, floors, and furniture, so as not to feel ourselves parting with our heat to surrounding objects. Besides this, the open fire enables each occupant of a room, by selecting his position, to regulate, according to his wishes, the amount of heat he desires to obtain from it.

On the other hand, stoves or pipes warm the air in contact with them, and give out a proportion of radiant heat, which passes to the walls of a room, dependant upon the degree of heat to which they are warmed. Thus with hot-water pipes, the temperature of which rarely exceeds from 120° to 150°, the larger proportion of the heat is employed to warm the air, and the walls and furniture of the room are only warmed by means of the contact of the air, and are thus necessarily somewhat cooler than the air itself.

The warmed air is less pleasant and invigorating to breathe than cold air; it leaves the walls colder than the air of the room, and the heat of the body is radiated to the colder walls; and to avoid this cause of discomfort the temperature of the warmed air is frequently raised beyond what is either comfortable or healthy for breathing, and thus discomfort in one form or the other can with difficulty be avoided.

On the other hand, when stoves or pipes are heated to a high temperature, the heat is partly communicated to the adjacent air, and partly acts as radiant heat to warm the surfaces adjacent.

This will be best explained by imagining a stove-pipe heated at the end nearest the stove to a dull red heat of 1230° Fahr., and of sufficient length to allow the heat to be diminished to 150° at the further end. It would then be found that at the stove end of the flue-pipe 92 per cent. of the total heat emitted by the pipe is given out by radiation to the walls, and only 8 per cent. to the air; but at the exit end the heat is nearly equally divided, the walls receiving 55 and the air 45 per cent. Taking the whole length of such a pipe, the walls would receive 74 per cent. and the air 26 per cent. of the heat emitted. But with a flue-pipe heated to lower temperatures the air would receive more than half the heat. When, therefore, the object is to heat the walls of the room rather than the air, which is sometimes the case, the temperature of the pipes should be high. Thus the character of the heat we desire to obtain must decide the form of heating, and the temperature to be maintained.

To ensure comfort it is essential to combine warmth in the walls and floors with cool air to breathe; as, for instance, air at a temperature of 54° to 64°. Radiant heat is therefore within limits the pleasantest kind of heat, and although there are other means of obtaining radiant heat to warm our rooms, such as gas fires, yet the open fire is at the same time so efficient as an engine of ventilation, that it would be very difficult even if it were desirable to replace it as the means of warming our rooms in this country.

The open fire, if it be looked upon as a mere heating agent, is somewhat wasteful. One pound of coal is far more than sufficient, if all the heat of combustion is utilised, to raise the temperature of a room, 20 feet square and 12 feet high, to 10 degrees above the temperature of the outer air. If the air of the room were not carried away up the chimney, and the walls were composed of non-conducting materials, the consumption of fuel to maintain this temperature would be very small.

But the principle of the ordinary open fireplace is that the coal shall be placed in a grate, to which air is admitted from the bottom and sides to aid in the combustion of the coal; and with an ordinary fireplace, for a room of 20 feet square and 12 feet high, the consumption may be assumed at about 8 lbs. of coal an hour.

Eight pounds of coal may be assumed to require, for its perfect combustion, 1280 cubic feet of atmospheric air; but in the best constructed furnaces or stoves at least twice the volume of air which theory demands for perfect combustion is carried up a chimney; and with the open fire, it will be found that at a very low computation of the velocity of the gases in an ordinary chimney flue the air would pass up the chimney at a rate of from 4 to 6 feet per second, or at from 14,000 to 20 000 cubic feet per hour; and with the chimneys in ordinary use, a velocity often prevails giving an outflow of air of from 25,000 to 30,000 cubic feet per hour.

The open fire, on that account, is a most efficient engine of ventilation, and the fuel which it consumes beyond what is required for warming is in reality a contribution towards the ventilation of a room.

This air comes into the room cold, and when it is beginning to be warmed it is drawn away up the chimney, and its place filled by fresh cold air.

A room 20 feet square, and 12 feet high, contains 4800 cubic feet of space. In such a room, with a good fire, the air would be removed four or five times an hour with a moderate draught in the chimney, and six or eight times with a blazing fire. The atmosphere of the room is thus being cooled down rapidly by the continued influx of cold air to supply the place of the warmer air drawn up the chimney. General Morin estimated that of the heat generated by fuel in an ordinary open fireplace, as used in France, less than about 15 per cent. produced a useful effect in the room, the remaining 85 per cent. being wasted through the brickwork of the fireplace, and through the chimney wall, as well as that which is carried away in the heated air up the chimney, whilst in the ventilating fireplace adopted for English barracks, he found that little more than 60 per cent. was wasted.

The Smoke Abatement Committee estimated that, in the specially constructed grates which they experimented upon, 58 per cent. of the total heat of combustion of coal from open grates was lost in the air up the chimney and in imperfect combustion, the remaining 42 per cent. being partly lost by conduction through the back and sides of the grate, and partly utilized in the room either by air-convection at the heated surfaces of the grate, or by radiation, the largest proportion of the heat which is utilized in an open fire comes from radiation. According to the results of M. Péclet's experiments, one-fourth of the total heat combustion of wood was radiated, and one-half that of charcoal; flaming fuel in the first case, flameless in the second case. In the case of coal, the proportion of heat radiated from the fuel varies between these limits.

Therefore, with an open fire, the very means adopted to heat the room tends to produce draughts, because the stronger the direct radiation, or rather the brighter the flame in an open fireplace, the stronger must be the draught of the fire and the abstraction of heat.

A fireplace is powerful enough to draw into the room all the air it wants; and for this purpose will use indiscriminately all other openings, whether inlets or outlets, if necessary.

The large volume of fresh air thus required to supply that drawn up the chimney cannot always be warmed with sufficient rapidity by contact with the walls and furniture only; the temperature in different parts of the room is therefore frequently very unequal.

The only way to prevent discomfort from this large volume of cold air is to adopt means for bringing in fresh warmed air at convenient places to supply that removed by the chimney.

The place for introducing the air depends on the action of the currents in the room produced by the action of the fire.

The way in which an ordinary open fireplace acts to create circulation of air in a room with closed doors and windows, is as follows:—The air is drawn along the floor towards the grate; it is then warmed by the heat which pervades all objects near the fire, and part is carried up the chimney with the smoke, whilst the remainder, partly in consequence of the warmth it has acquired from the fire, and partly owing to the impetus created in its movement towards the fire, flows upwards towards the ceiling near the chimney breast. It passes along the ceiling, and as it cools in its progress towards the wall opposite to the fire, descends to the floor, to be again drawn towards the fireplace.

It follows from this, that with an open fireplace in a room, the best position in which to deliver the fresh air required to take the place of that which has passed up the chimney, is above the projecting chimney-piece, and at any convenient point in the chimney breast, between the chimney-piece and the top of the room, for the air thus falls into the warmer upward current, and mixes with the air of the room, without perceptible disturbance.

The open fireplace thus presents special advantages for securing efficient ventilation by means of the circulation of air which it creates. It makes the room in which it is in use independent of other means of extraction of air, unless the room is very crowded, or beyond the size for which the fireplace is calculated.

If the fresh air thus supplied be properly warmed, it will prevent inequalities of temperature in the room. This warmed air may be supplied by means of a flue connected with a calorigen placed in some central position, or it may be brought into the room directly from the open air and passed through a coil of pipes in the room itself, heated by hot water or by steam.

In this country the climate is so uncertain, and it is often so mild in the winter, that it is a great advantage for each room to be self-contained in respect of its warming and ventilation. For this purpose the simplest plan is to utilize some of the waste heat which, in the case of an ordinary fireplace, passes away unused up the chimney.

The ventilating fire-place designed for use in barracks by the author of this handbook, although adopted nearly twenty-five years ago, still remains the simplest and most efficient form of open fireplace, combining ventilation with warming and economy of fuel. (Fig. 16.)

Fresh * air is admitted to a chamber formed at the back of the grate, where it is moderately warmed by a large heating-surface, and then carried by a flue adjacent to the chimney-flue to the upper part of the room, where it flows into the currents which already exist in the room.

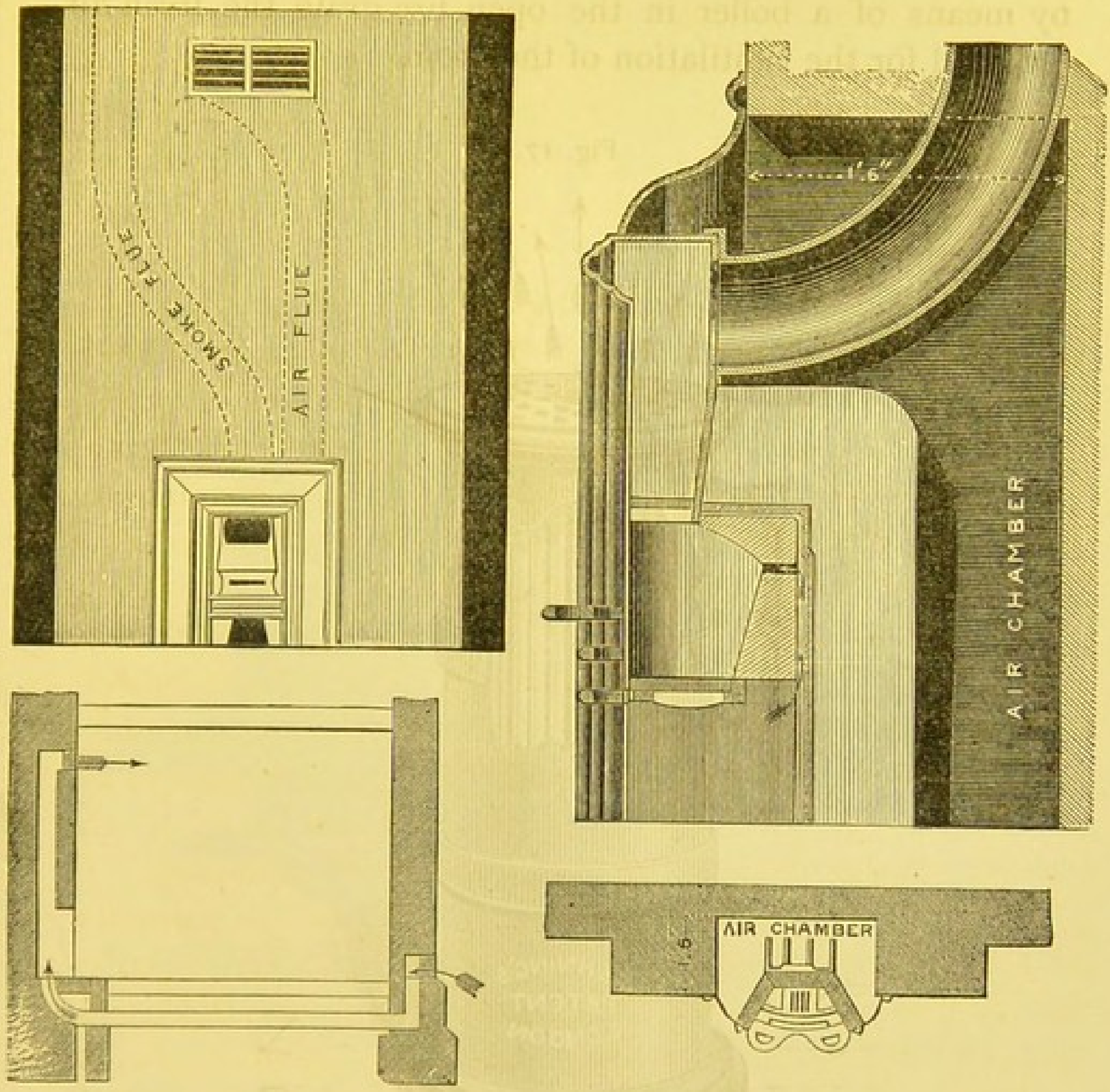
The effectual combustion of the coal is obtained by

---

* These grates are made by Messrs. Yates & Haywood, Rotherham Wharf, Upper Thames Street, E.C., and by Messrs. Kennard, Upper Thames Street.

limiting to a certain extent the draught at the bottom of the grate, but supplying warmed air on to the top of the fuel at the back of the fire.

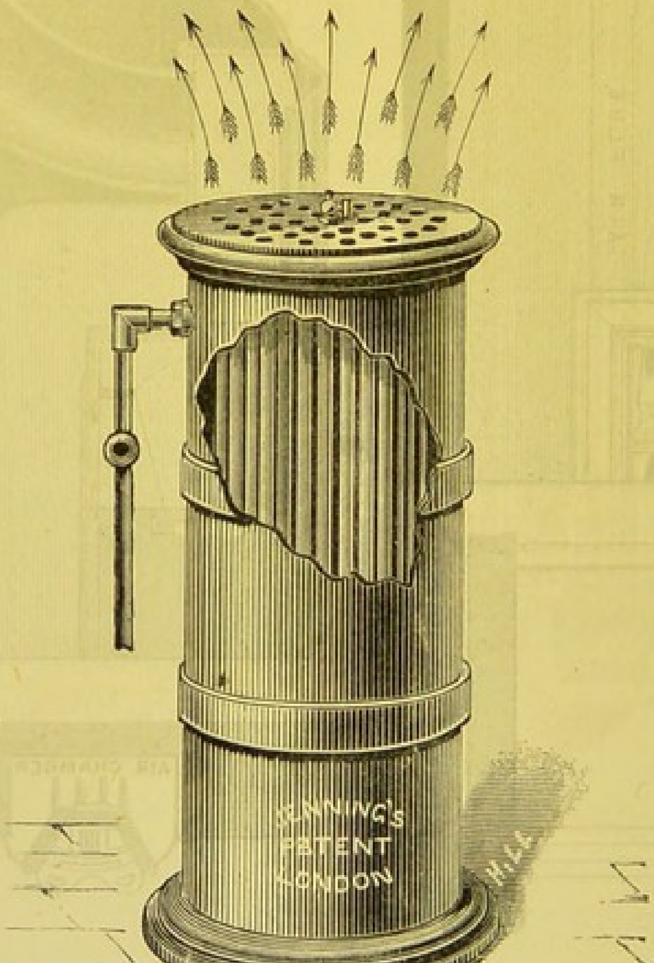
Fig. 16.



The ventilating fire-place thus retains the advantage of giving out radiant heat; and it provides ventilation without draughts by admitting air moderately warmed into the room at a convenient point, to replace the air which is removed by the chimney.

There are several forms of grates devised to warm fresh air by the direct heat from the back or side. Another way is to place a small boiler in the fire, with which pipes are connected leading to coils of pipes or small cisterns of hot water, with tubes through which the incoming fresh air is passed. Colonel Thorneycroft has adapted a plan of this sort to a bedroom or dressing-room, adapted also to warm or dry articles of clothing. Figures 17 and 18 show an arrangement proposed by Messrs. Jennings' for warming by means of a boiler in the open fire-grate the fresh air required for the ventilation of the room.

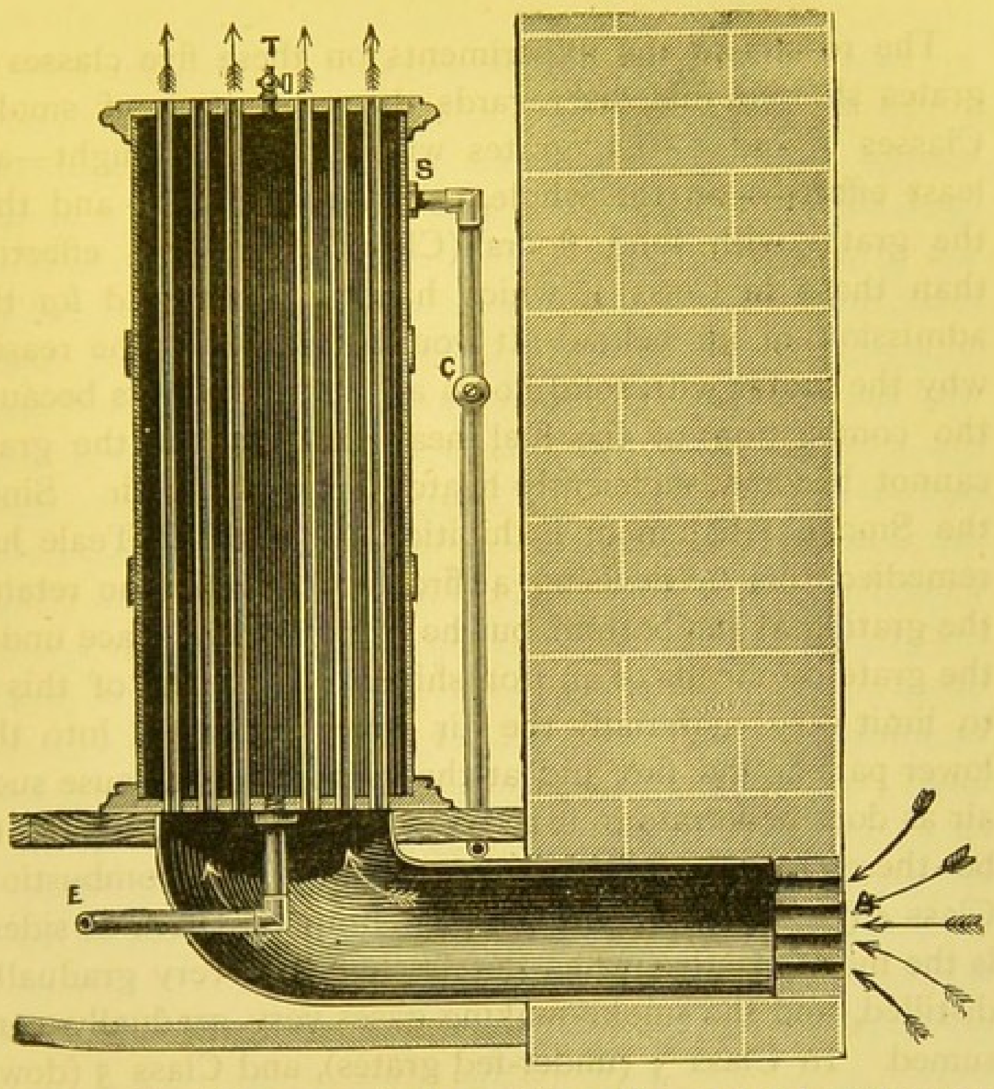
Fig. 17.



It is thus possible with the open fireplace to keep the warming and ventilation of each room distinct from that of the remainder of the building, provided the heat of the fire is utilized to warm the incoming fresh air in some way or other.

There have been numerous varieties of open fireplaces invented in recent years, with the object of improving the combustion of the fuel, mainly with the object of preventing smoke: and in the very interesting experiments made by

Fig. 18.



the Smoke Abatement Committee, the several grates experimented upon were classed as follows:—

Class 1. Open grates, having ordinary bottom-grids and upward draught.
" 2. Open grates, having solid floors, adapted for "slow combustion," and upward draught.
" 3. Open grates, under-fed, supplied with fresh fuel beneath the incandescent fuel, with upward draught.
" 4. Open grates, to which fresh fuel is supplied

from the back, or from the sides, or from hoppers.

Class 5. Open grates, having a downward, or a backward, or a lateral draught.

The results of the experiments on these five classes of grates showed that, as regards the prevention of smoke, Classes 1 and 2—*i.e.*, grates with upward draught—are least effective, on the whole, to prevent smoke; and that the grates with solid floors (Class 2) are less effective than those in Class 1, which have an open grid for the admission of air below. It would appear that the reason why the grates with solid floors are not efficient is because the combustion of the fuel near the floor of the grate cannot become sufficiently heated for want of air. Since the Smoke Abatement Exhibition, Mr. Pridgin Teale has remedied this by devising a fireplace in which he retains the grating at the bottom, but he closes up the space under the grate by means of an iron shield. The effect of this is to limit very materially the air which can pass into the lower part of the fire, and at the same time to cause such air as does penetrate to it to be very highly heated, and to be therefore in a favourable condition for combustion. Class 4 (*i.e.*, grates fed by hoppers from the back or sides) is the most effective when the fresh fuel is very gradually distilled, and the smoke-making gases very gradually consumed. In Class 3 (under-fed grates), and Class 5 (down or back-draught grates), in which the gases are drawn upwards or downwards through the incandescent fuel, although, no doubt, the gases are at a temperature sufficient for complete combustion, yet the supply of air appears to be insufficiently mixed with the gases to complete the combustion.

As regards the elevation of temperature in the room from the combustion of fuel in the fireplaces of the grates experimented on, those with ordinary fires, having bottom grids (Class 1) or solid floors (Class 2), are the least effective for warming the room relatively to the quantity of coal consumed per hour. Next in order are open fires feeding at the sides or the back, or from hoppers (Class 4). Then follow the grates of Class 5, having a downward or a horizontal draught; and lastly, as the most efficient of the open grates, those which are under-fed, with an upward through draught (Class 3)—one-third better than those of Class I.

From these experiments it seems that open grates (Classes 3 and 5), constructed on the principle of drawing the combustible gases through the incandescent fuel, are the most efficient; and that, of these, the best are those (Class 3) which supply the fresh fuel below the fire, and cause the combustible gases to rise upwards through it.

The under-fed open grates (Class 3) are the only grates which are capable of continuously exposing a bright and open surface, unchecked by the presence of fresh coal as well as of smoke, and unobstructed by special appliances; these grates therefore continuously expose a clear fire, from which heat should be continuously radiating, and from this cause it seems probable that the apparent excellence of the grates of Class 3 amongst other open grates is very much attributable to this distinctive characteristic.

Some of the grates experimented upon by the Smoke Abatement Committee were ventilating, *i.e.*, they supplied fresh warmed air to the room. But there were marked differences in the variations of temperature in the room at various levels between the air-heating and the non-air-heating grates and stoves.

It appeared that the uppermost part of the room heated with open grates was much warmer—by as much as nine degrees in most instances—than the lowermost parts. It also appeared that the employment of means of introducing warmed air into the apartment, and of ventilating it, was not necessarily influential in reducing inequalities of temperature at different levels. In some cases it appeared, on the contrary, to augment the actual difference that arises when no special ventilating and warming contrivances are provided. This seems to depend on the volume of fresh warmed air, on the temperature at which it comes in, and on the place where introduced; that this is so is evidenced from the fact added, that other experiments which have been made, some by General Morin, and some by the Army Sanitary Commission, on the Galton ventilating fireplace used in barracks, which latter was not brought into competition or tested at the Smoke Abatement Exhibition, showed that when this grate was in full action, and the windows and other means of ventilation closed, thermometers in all parts of the room, and near the ceiling and floor, sheltered from the radiation of the fire, did not vary more than 1° Fahr.

The fact is, that this grate supplies a large volume of air at a moderate temperature, delivered in a position to enable it to intermix under favourable circumstances with the currents of air in the room caused by the open fire, and this secures equalisation of temperature over the room.

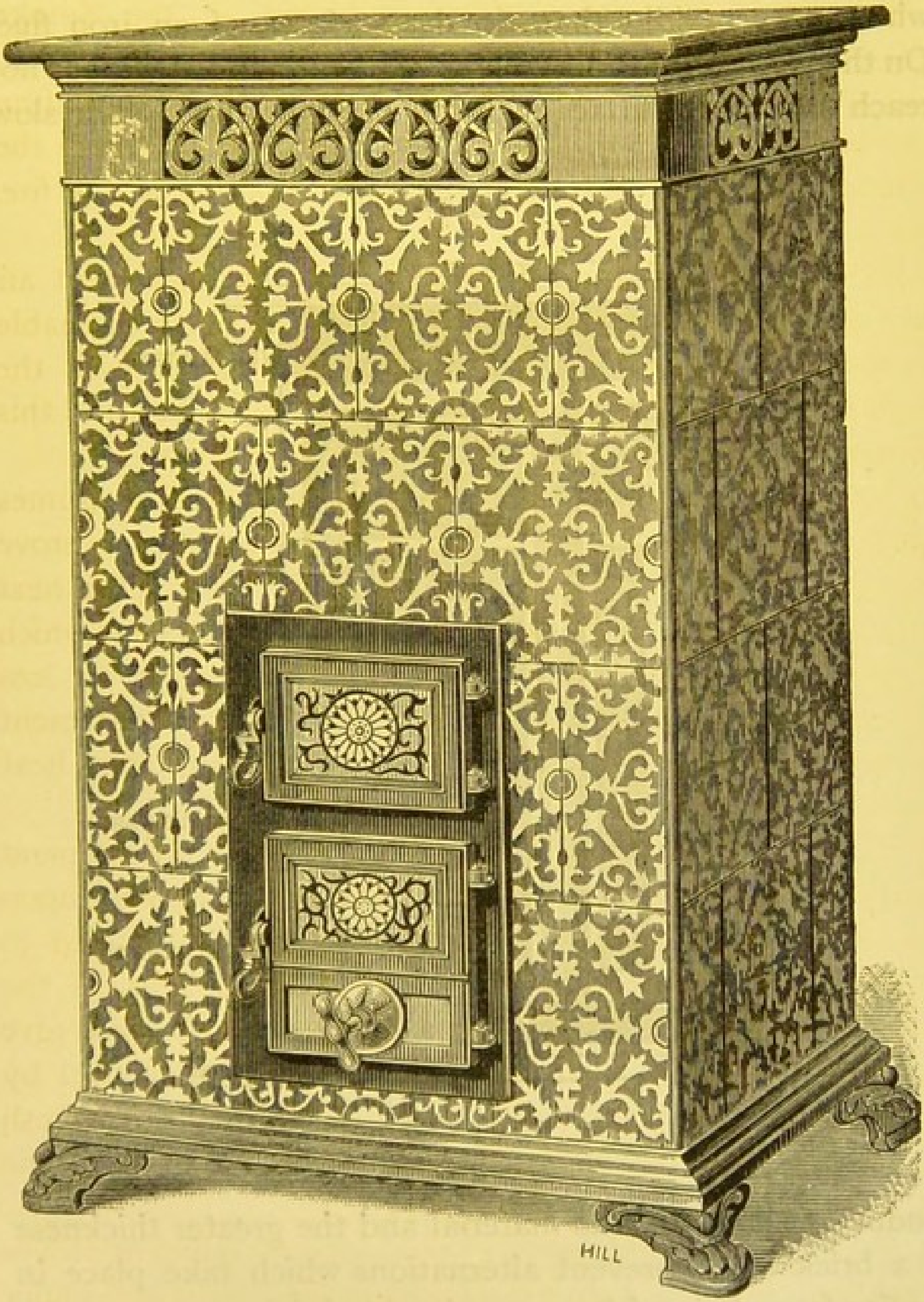
A stove, as distinguished from an open fire, consumes the fuel in a close receptacle. Consequently a stove absorbs, utilizes, and gives out sooner or later all the heat which the fuel develops, except that part of the heat which passes away to the chimney-flue. The amount so lost was shown by the experiments of the Smoke Abatement Committee to average about 24 per cent. of the total heat evolved by combustion.

The advantage to be derived from a stove will depend partly upon its material and construction, and partly upon its position with reference to the space it is designed to warm. For whilst, according to the experiments of the Smoke Abatement Committee, an efficient stove will give out into a room nearly 76 per cent. of the heat evolved by combustion, if it be placed in a basement to warm fresh air, which is carried up by flues into various parts of the house, other conditions will prevail.

As regards the difference in the value of different stoves as producers of heat, this depends on the conditions under which the heat evolved by combustion is utilized and transferred from the fire to the air through the material of which the stove is composed.

In a close stove heated to a moderate temperature, the heat, as it passes from the fire, warms the surface of the materials which enclose and are in contact with the fire and with the heated gases, and the heat is transferred through

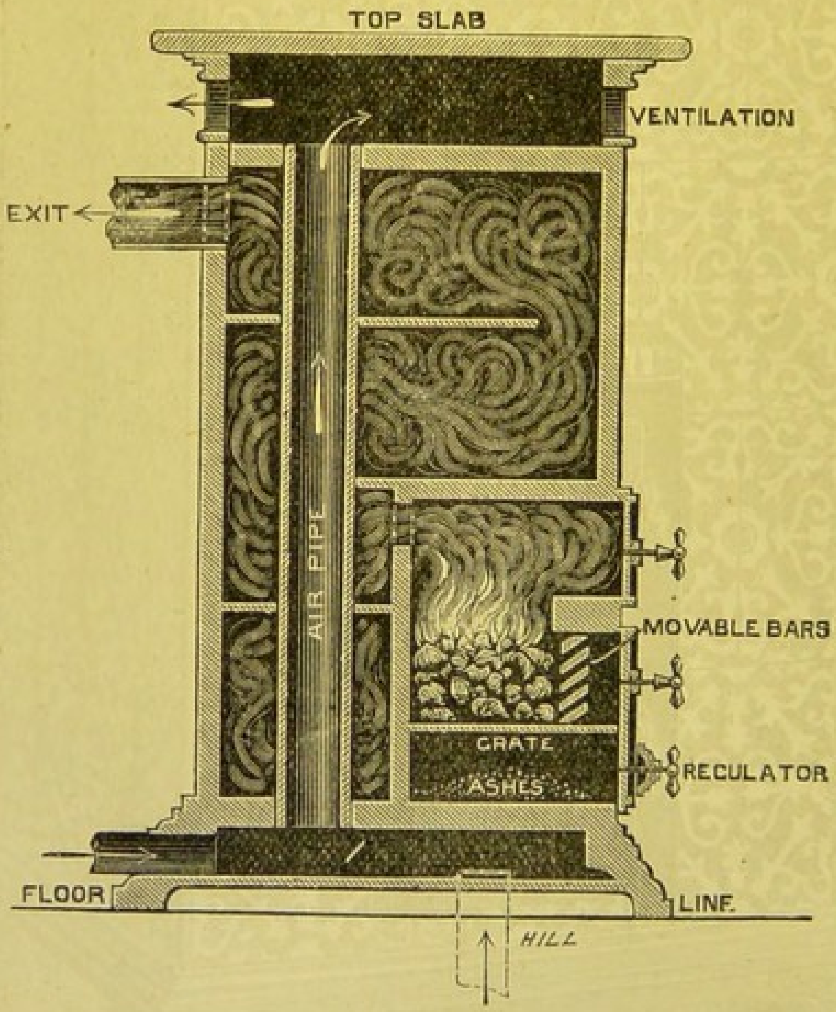
Fig. 19.



the materials to the outer surface in contact with the air, and the air is warmed by the agency of this outer surface. An iron stove made red hot will give out radiant heat, which passing through the air warms the objects on which the rays impinge.

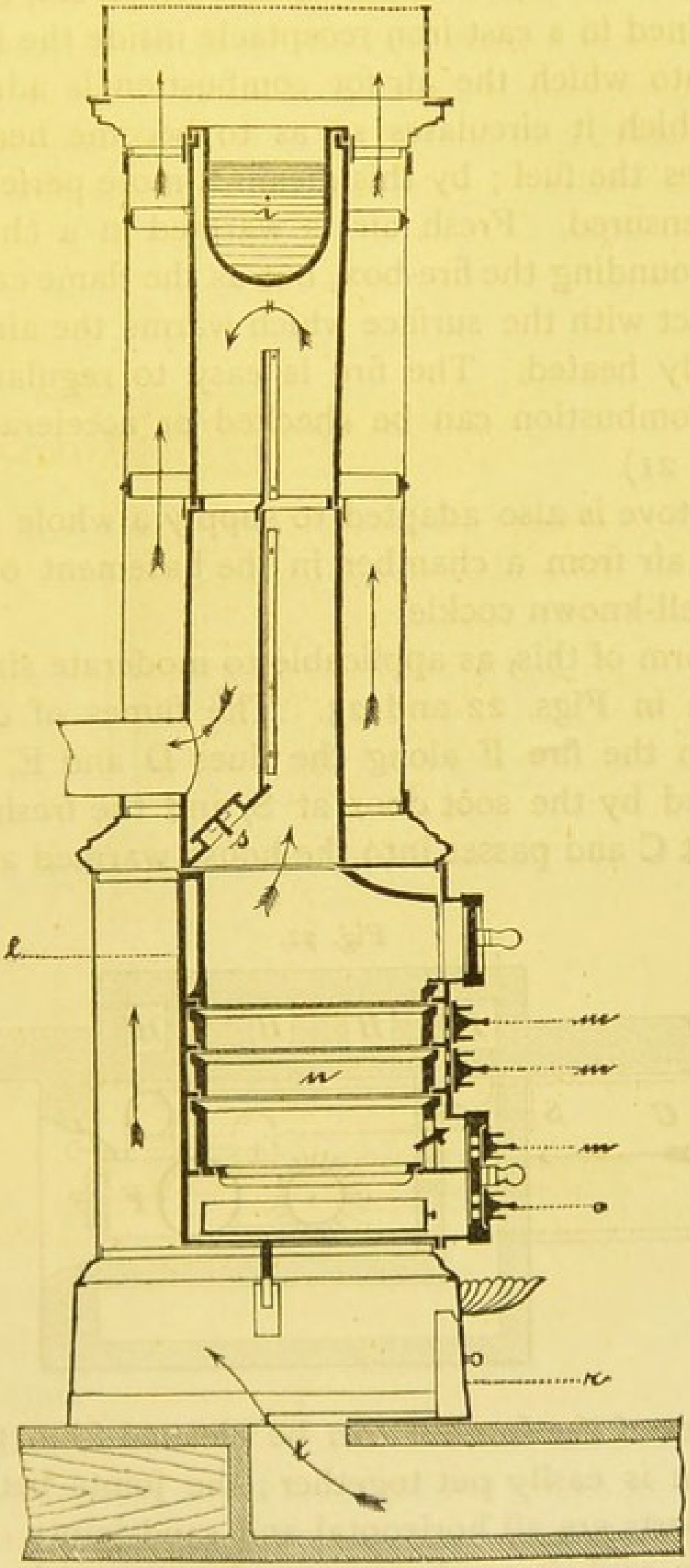
Brick stoves and flues are worse conductors of heat than iron stoves or flues; but the surface of a brick stove, especially if glazed, parts with the heat, which reaches it somewhat more rapidly than do the surfaces of an iron flue. On the other hand, the whole of the heat generated does not reach the outer surface with the same rapidity. The slow conducting power of the material and the greater thickness of a brick stove prevent alternations which take place in the fire from being felt so much with brick stoves as with iron stoves or flues; and therefore the brick stove warms the air more equably without sudden variations. The air so warmed is free from objectionable effects, and where

Fig. 20.



they can conveniently be applied, it is advisable to use brick stoves for warming air for ventilating purposes.

Fig. 21.



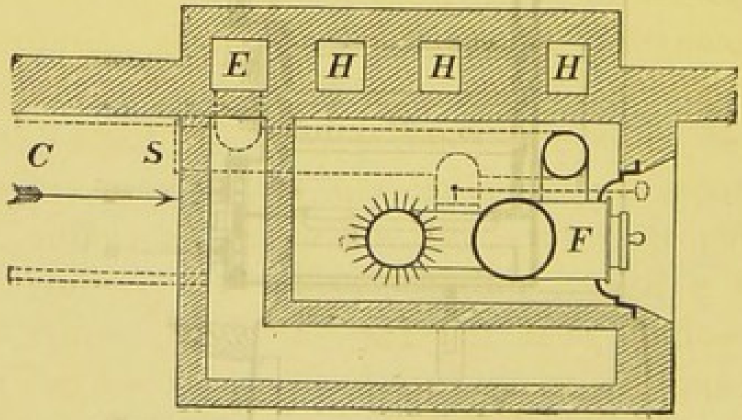
Doulton's German stove deserves notice as a convenient and efficient means of warming. See Figs. 19 and 20.

Amongst the newer forms of iron stoves in the Exhibition may be mentioned, for simplicity and efficiency, that of Mr. A. B. Reck, from Copenhagen. The principles observed in the construction of this stove are, that the fire is contained in a cast-iron receptacle inside the body of the stove, into which the air for combustion is admitted, and round which it circulates so as to become heated before it reaches the fuel ; by this means a more perfect combustion is ensured. Fresh air is warmed in a chamber and pan surrounding the fire-box, but as the flame cannot come in contact with the surface which warms the air, it cannot be unduly heated. The fire is easy to regulate, and the rate of combustion can be checked or accelerated at will (see Fig. 21).

This stove is also adapted to supply a whole house with warmed air from a chamber in the basement on the plan of the well-known cockle.

The form of this, as applicable to moderate sized houses, is shown in Figs. 22 and 23. The fumes of combustion pass from the fire F along the flues D and E, which can be cleaned by the soot door at S, and the fresh air comes in cold at C and passes into the house warmed at H.

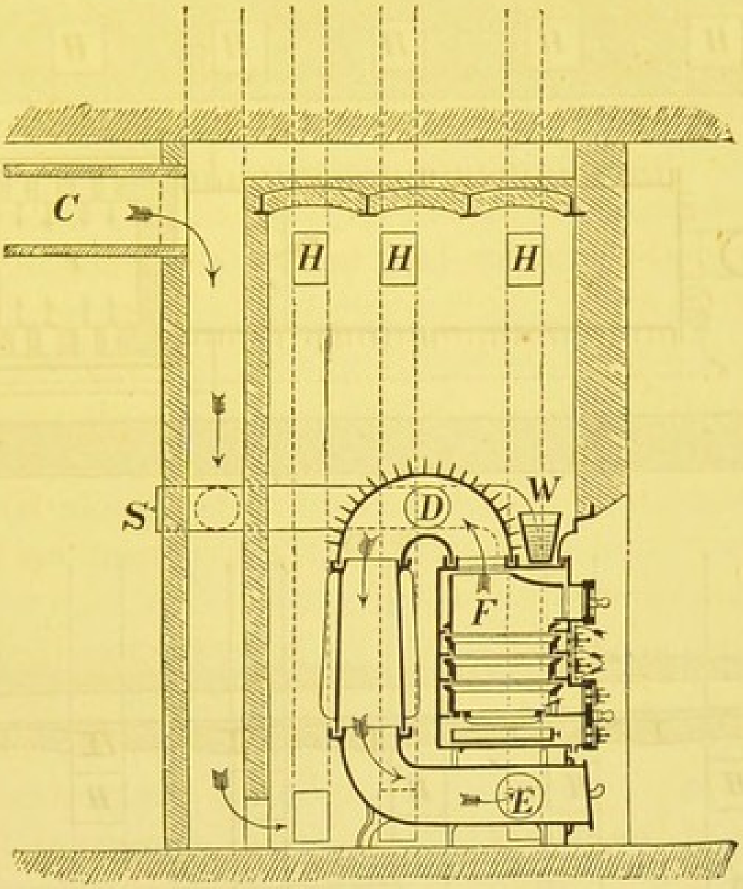
Fig. 22.



The flues of the furnace can be cleaned from the front; the furnace is easily put together; the joints between the different parts are all horizontal and sand-joints. It burns bituminous coal, it produces scarcely any smoke, and the fire can be left for from seven to ten hours without attention.

Reck's stoves have been largely applied in Denmark to the warming of schools, and other institutions, by

Fig. 23.



leading the warmed air from a chamber in the basement to the rooms by means of flues from a chamber in the basement (Figs. 24 and 25). In order to obtain a circulation of air in the room, extraction-shafts are placed in each room for removing foul air. These are made to open either near the floor or near the ceiling. When warm air is passed into the room, the opening into the extraction-shaft near the floor is used; when there is no heat applied to the fresh air, the opening near the ceiling is used.

The improved form of fire-box gives these stoves some advantages over the old form of cockle in the more equable maintenance of the fire. This mode of warming air enables the heat to be got up rapidly, but if the fire gets low the temperature falls rapidly. In order to enable the person in charge of the fire in the basement to know the temperature of the several parts of the building, thermometers

Fig. 24.

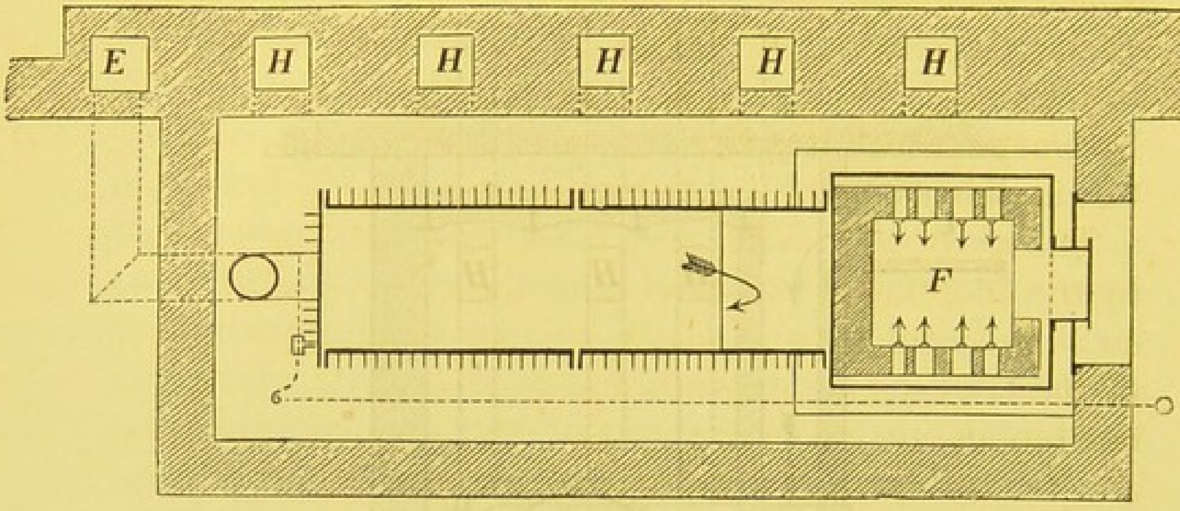
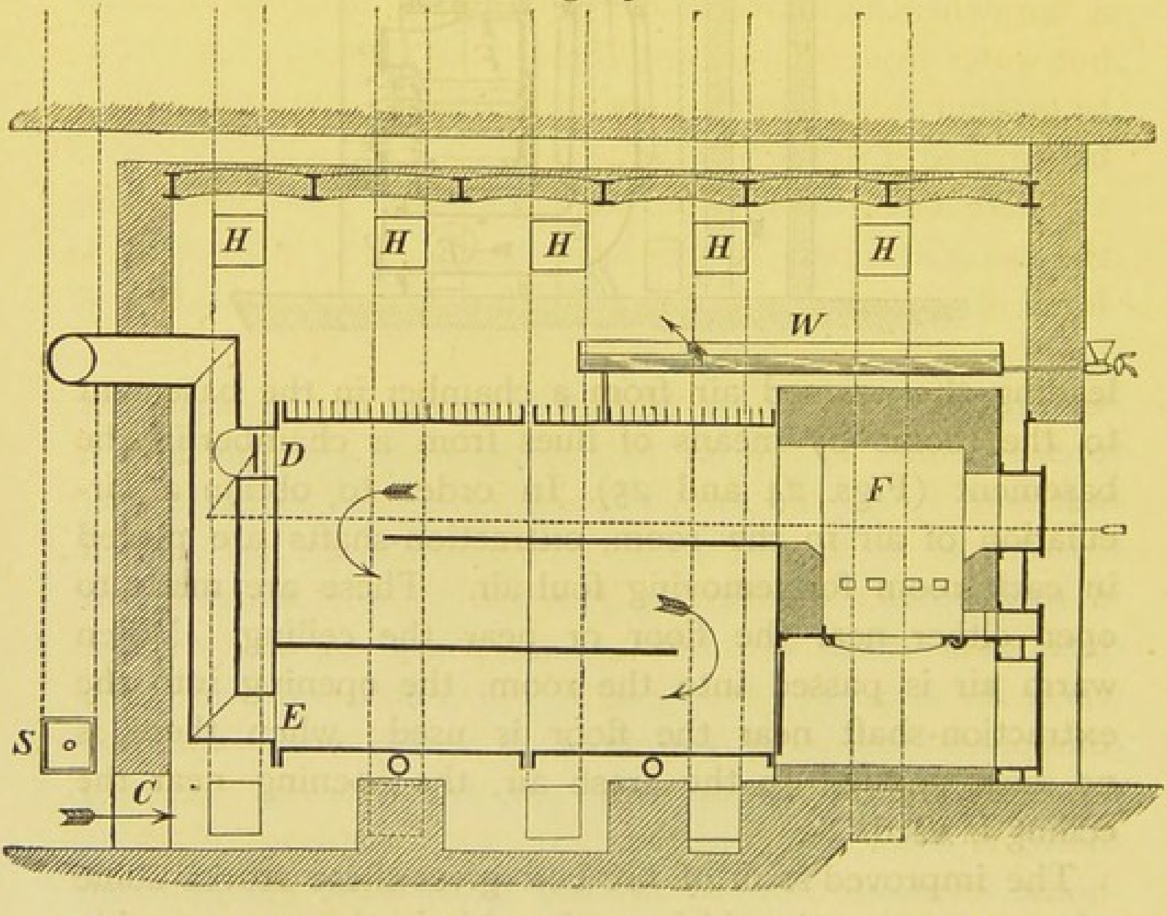


Fig. 25.



based on the expansion of air are in use in Denmark. These thermometers consist of a metal cylinder about 8 inches long by 3 inches diameter, which is fixed in the room whose temperature it is desired to ascertain. This is air-tight, except that a fine tube of gas-pipe metal about $\frac{1}{8}$ inch outside diameter is carried from it to the open end of a barometer placed near the stove in the basement, with which it is connected by means of an air-tight connection in the basement. The expansion and contraction of the air in the metal cylinder in the room is thus transferred to the barometer, which is graduated so as to enable the temperature in the room to be known by the pressure thus registered.

The use of cockles has been much superseded in England by the adoption of hot-water pipes for warming and cooling air. Sylvester, who probably in this country carried out to the largest extent the principle of warming houses and institutions by means of heated air from the basement, adopted the plan of heating the air in a chamber in the basement by means of hot-water pipes, arranged to afford a large heating surface, and these pipes were warmed by hot water from a large-sized boiler, the object of which was to prevent rapid alternations of heat and cold in the air to be warmed if the fire became low.

There is no doubt that in the cost of first installation the use of warmed air from the basement is the cheapest form of warming a house. In this country, however, the great extension which has taken place in the use of hot-water pipes carried throughout a building has, at the present time, almost entirely superseded this method of warming fresh air. In the case, when the room is heated by means of the warmed air alone (which is supplied from a stove in the basement), the air, after being warmed, will lose more or less of its heat in passing along the flues. If these flues are of great length, in a situation exposed to damp, and formed of materials which are good conductors of heat, much heat may be lost in transmission. It must, however, be remembered that flues entirely inside a house, even if they absorb the heat, must give out the heat again into the house somewhere. It is on this account that it is so much more advantageous to place chimneys in the inside walls of a house, so that the heat which the brickwork absorbs during the passage of the smoke passes into the house instead of into the open air, which is so largely the case with chimneys in outside walls.

The method of heating a house by the supply of warmed air from the basement is decidedly economical in the first installation. It is, however, to be observed that the walls must necessarily be somewhat cooler than the air which warms them, and therefore this mode of heating is not comfortable unless supplemented with some form of radiant heat. On this account it has generally been used in connection with an open fireplace. If, however, it be used alone, the only way in which it can be applied so as to be comfortable is to bring in the warmed air through hollow spaces in all the walls, so that the walls would be warmed by the air before it enters the room ; and thus the radiation from the bodies of the occupants to walls colder than the air of the room would be prevented. This would be somewhat uneconomical when applied to outside walls, because so large a portion of the heat would pass away unutilized to the outer air through the outer surface of the wall.

The efficiency of hot water as a means of heating depends upon the heated water reaching the coils of pipes where the heat is to be utilized with as little difference of temperature from that prevailing in the boiler as possible. The velocity of flow in the pipes will depend upon the difference of temperature between the water as it leaves the boiler and the temperature at which it passes down the return pipe back into the boiler ; and partly upon the height to which the heated water has to rise.

It follows, therefore, that the upward flow of the heated and expanded water, as it passes from the boiler, should be as direct as possible, and be so protected as to lose as little heat as possible between the boiler and the place where the heat is to be utilized.

On the other hand the return pipe, which brings back the water to the boiler after the heat has been utilized in the coils employed in warming the air, need not be protected, and it should be passed into the bottom of the boiler as directly, and in as uniform a line from the place where the heat has been used, as possible.

When the water circulates through the pipes by virtue of the difference of temperature of the flow and return currents only, it is impossible to count upon a greater mean temperature in the pipes than from 160° to 180°, because above that temperature the water in the boiler begins to boil, and causes an overflow of the supply cistern and escape of steam at the air-pipes. In order to obtain a sufficient velocity of circulation for long distances, or with small differences of level, a forced circulation may be resorted to, as has been done by Messrs. Easton and Anderson at the County Lunatic Asylum at Banstead.

In the ordinary system of heating by hot water the temperature of the pipes can be raised or reduced if desired, and this plan gives the power of regulating the range of temperature, to meet the various changes in the external atmosphere. But with low temperatures the greater part of the heat is employed in warming the air, and a very small proportion acts as radiant heat to warm the walls. By heating water under considerable pressure a much higher temperature may be obtained than from low pressure hot-water pipes, probably from 260° to 280°.

Pipes heated by hot water under pressure convey heat to the air with greater rapidity than pipes heated by hot water at low pressures. And in addition to the increased direct effect which pipes heated to a high temperature by water under pressure have in heating the air, is the collateral advantage of the consequent radiation of a larger proportion of heat to the walls of a room than takes place with pipes heated under ordinary circumstances. The most convenient form of applying this method is Perkins' system, by which the water is heated under considerable pressure.

In its simplest form the apparatus consists of a continuous or endless iron tube of about one inch diameter, closed in all parts and filled with water. The joints are screw joints connected within a socket forming a right- and left-hand screw. About one-sixth part of the tube is coiled in any suitable form and placed in the furnace, forming the heating surface, and the other five-sixths are heated by the circulation of the water which flows from the top of this coil, and after having been cooled in its progress through the building, returns to the bottom of the coil to be reheated.

As these pipes are absolutely closed so that there can be no evaporation, they will, when once fitted and in operation, go on for years without any alteration being necessary.

This system is an approach to steam in the temperature it obtains in the pipes, but it is free from the necessity of supplying water to the boiler, or of having safety-valves, &c.

Steam-pipes for heating present many advantages. In the first place steam is easily led to great distances. In the next place as steam-heated pipes are hotter than hot-water pipes, their effect in warming the air in contact with them is also greater; and therefore, when heating is required on a large scale, it will be found that it is more economical to use steam-pipes than hot-water pipes; besides which, the pipes may be smaller, and thus in both ways expense is saved. Highly heated steam-pipes, moreover, radiate a large portion of their heat to the walls and furniture of a room. Heating by steam is universal in the United States, and the usual system may be described as follows:—

The steam is conveyed from the basement along pipes to the room or passage where it is wanted to be used, and there it is passed into a cluster or coil of pipes called a radiator, which gives an enlarged heating surface. The cause producing the circulation throughout the pipes of the warming apparatus is solely the difference of pressure which results from the more or less rapid condensation of the steam in contact with the radiating surfaces; a partial vacuum of greater or less amount is thereby formed within the radiating portions of the apparatus, and the column of steam or of water equivalent to this diminution of pressure constitutes the effective head producing the flow of steam from the boiler; while the return current of condensed water is determined by the downward inclination of the pipes for the return course. Therefore the flow-pipe should be carried in as direct a line as possible from the boiler to the highest point; all the coils for heating should be placed on the return pipe, which should be laid in a uniformly descending line back to the boiler, so arranged as to prevent the lodgment of any condensed water on its way there; because if condensed water lodges in the pipes most unpleasant and startling noises result. It is a source of economy in steam-heating that the condensed water should flow back to the boiler.

This is what is called closed circulation, with separate supply and return mains, both of which extend to the furthest distance to which the heat has to be distributed. It is, however, possible to carry the steam and bring back the condensed water by means of a single main, which answers at once for both the supply and the return, either with or without a longitudinal partition inside it for separating the outward current of steam supply from the return current of condensed water. If more convenient, the return of the condensed water to the boilers may be dispensed with, and the steam may be applied in what is called the system of *open circulation*, where a supply main conveys the steam to the radiating surfaces, whence a return main conducts the condensed water either into an open tank for feeding the boiler, or into a drain to run to waste, or for use as hot water, the boiler being then fed from some other source; in either case suitable traps have to be provided on the return main, for preserving the steam pressure within the supply main and radiators.

Steam-heating no doubt possesses some disadvantages, but much of the bad name which steam-heating has acquired is due to the want of a proper system of ventilation in connection with its use.

The heat given out is very great, and becomes often oppressive. Under the ordinary arrangements for steam-heating, the temperature of the pipes cannot be regulated as with hot water. This latter objection is met to some extent by separating the coils into parts, which can be put in operation consecutively.

In the New York Hospital the incoming air is warmed by coils of steam-pipes, and generally to a considerable temperature; but in order to prevent the warmed air entering the wards at too high a temperature, this hot air is passed into a mixing-chamber, to which cold air can be admitted at will, so that the hot air can be mixed with cold air to the extent necessary to moderate its temperature before it is allowed to flow into the wards.

But whatever may be its disadvantages, steam-heating possesses the great advantage of being easily distributed; and from its use in distributing heat to considerable distances great economy and convenience result. The fires can be concentrated in one spot, by which a considerable saving can be made, both in labour and fuel. It is this saving in labour which has led the Americans to adopt a plan in several towns for consuming the fuel at a central source of supply, and sending thence the heat itself to supply the several houses in connection with it; and the system thus dispenses with the necessity for consuming the fuel in each individual house, because all hot water required for domestic use can be obtained from the steam, and other cooking is done by means of gas.

Gas would not be economical as a fuel for heating purposes on a large scale, yet it possesses many advantages from the ease with which it can be applied so as to be brought into use rapidly, and put out with equal rapidity. This quality is of especial use in a country like England, where the climate is variable, and the cold is rarely, for any length of time even in winter, very intense.

Gas has been applied to open fires by utilizing its heat so as to make fire-clay or asbestos incandescent, and it has also been applied to stoves. It should be an axiom in heating by gas that no arrangement is admissible in which the products of combustion are not carried off to the outer air. The best are those in which the products of combustion are carried away, and the heat used to warm fresh air admitted to the room.

The methods of heating by gas have been very much improved lately.

In the experiments made by Mr. D. K. Clark for the Smoke Abatement Committee on heating by gas, it appeared that the rise of temperature was 1° Fahrenheit for five cubic feet of gas per hour. But in more recent experiments made by him for the jurors of the Gas Exhibition of the Crystal Palace, much more favourable results were obtained.

The gas-heating apparatus fall under three classes:—1st, close stoves; 2nd, open stoves, viz., (*a*) asbestos fuel stoves, (*b*) tile stoves, (*c*) reflector stoves; 3rd, gas fires.

The general results were as follow:—

	Gas per hour per degree of Elevation of Temperature. cub. ft.
Class 1.—Close Stoves	1·65
„ 2.—(*a*) Asbestos Fuel Stoves	2·05
„ 2.—(*b*) Tile Stoves	1·84
„ 2.—(*c*) Reflector Stoves	1·55
„ 3.—Gas Fires	1·57

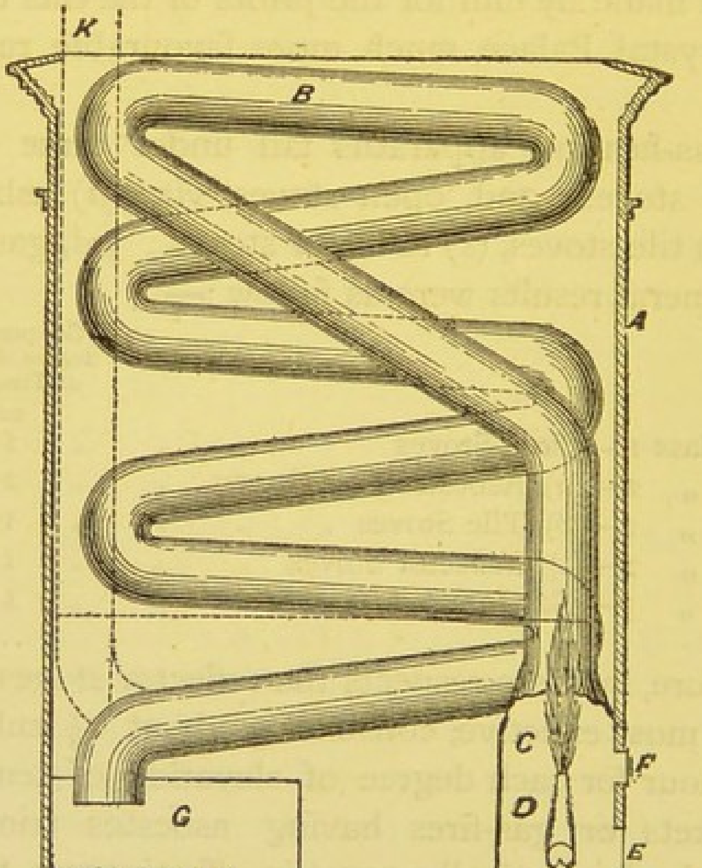
Therefore, in these respects the reflector stoves of Class 2 were the most effective, consuming about 1½ cubic feet of gas per hour for each degree of elevation of temperature; gas-brackets or gas-fires having asbestos trimming are next—indeed, practically equal in effectiveness to reflector stoves. Next in order are close stoves, then tile stoves; and lastly, asbestos fuel stoves, the least effective of all, in which 2 cubic feet of gas are consumed per hour per degree of elevation of temperature.

Taking the cost for gas at 3*s.* 6*d.* per 1000 cubic feet, the cost of 1½ to 2 cubic feet per hour would amount to from 0·063*d.* to 0·084*d.* necessary to maintain the 1° Fahr. rise of temperature.

To compare the cost of heating by gas with the cost of heating by coal, Mr. D. K. Clark's experiments for the Smoke Abatement Committee showed the average rise of temperature per pound of Wallsend coal consumed per hour to be 4·14° Fahrenheit per hour. Allowing 20*s.* per ton as the cost of coal, it would cost 0·024*d.* to do the same duty as gas, as shown above.

Among the more recent adaptations of gas to the purposes of warming air is Messrs. Boyle's Warm-air Inlet Ventilator.

Fig. 26.

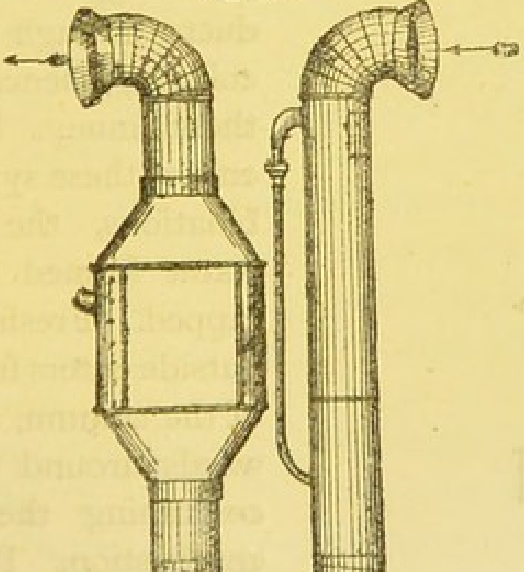


This has been applied at the Guildhall. The air is extracted from the ceiling of the Council-chamber by means of some of Mr. Boyle's ventilating cowls ; whilst the fresh air to replace that so extracted is supplied as follows :—On the south side of the chamber four vertical air-tubes or brackets are fixed against the wall, 2 feet by

2½ inches by 3 feet, the other two placed a little higher up in the wall, being 1 foot 6 inches by 4 inches by 2 feet. These tubes communicate with holes cut through the walls, 2 feet by 8 inches, finished with cast-iron gratings. These air-inlets are all fitted with Messrs. Boyle's patent heaters for warming the supply of air to any temperature required as it passes into the building; the north wall is similarly treated to the south, with the exception of having an extra tube at the end where the Lord Mayor sits. At the public end of the chamber three inlet-tubes are fixed, one at each side and one in the centre, also fitted with the air-warming arrangement. An abundant supply of air is admitted through these tubes, and tests have shown that the air can be warmed in cold weather to a temperature of from 60° to 120°, thus preventing cold draughts.

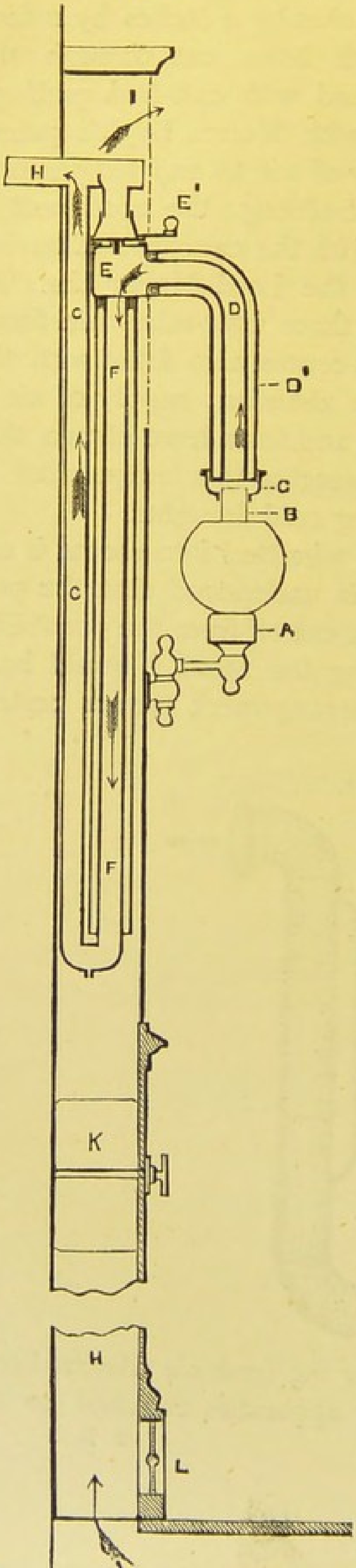
This plan of warming the air admitted into rooms is undoubtedly simple; and as it is understood that the products of combustion are entirely cut off from the possibility of passing into the air entering the room, it would be a very convenient and useful arrangement under certain circumstances.

Fig. 27.



Another method for warming the fresh air admitted to a room, by means of a heating apparatus attached to the

Fig. 28.



inlet-tube, is adopted by the Æolus Ventilating Company, and shown in the accompanying woodcut. (Fig. 27.)

Messrs. Strode have a gas-heating stove, namely, Schönheyder's Sanitary Stove, which, whilst acting as a means of lighting a room, is also adapted for heating and ventilating. (Fig. 28.)

In the two-light stove of this pattern, two Argand Gas-burners are fixed to the column. The burnt gases are taken inside the column, and pass downward through two 2-inch tubes, about 3 feet in length, and then upwards through two other tubes, 3½ inches in diameter, about 4 feet long, which lead the products through the top of the column, whence they pass to the chimney. From the lower end of these syphon-like combinations, the condensation water formed in the pipe is tapped. Fresh air from the outside enters from the bottom of the column, and passes upwards around the four pipes containing the products of combustion. It is heated as it ascends, and is discharged into the room at the upper part. The vitiated air of the room is in winter season passed through the base of the column, and conducted direct to the flue. In summer the burnt gases, with the vitiated air, pass direct to the chimney, without traversing the syphon pipes. The first pipes, or those which first receive the burnt gases, are air-jacketed in order to prevent the scorching of incoming fresh air. Means are provided for moistening the air.

Mr. D. K. Clark's experiments showed that in this stove a consumption of 1·74 cubic feet of gas per hour was required to maintain 1° Fahrenheit of rise of temperature.

The method of warming and ventilating to be adopted in each house mainly depends upon special conditions of occupancy.

Where the rooms are never likely to be very fully occupied, and where the method of lighting is such as to prevent the light from having contact with the air, it is possible that the flue from an open fire will effect all the ventilation that is necessary, and if this be combined with a ventilating grate which admits moderately-warmed fresh air, the room will be comfortable and healthy. In all rooms, however, where large numbers are liable to congregate, or where the air is likely to have exceptional causes of vitiation, such as dining-rooms or rooms for large parties, some special outlets for vitiated air are necessary, in addition to some form of inlet to admit fresh air. This incoming fresh air should be capable of being more or less warmed, according to the state of the weather.

This is so far as the rooms themselves are concerned; but as regards the house generally, it may be accepted as an axiom that no house will be comfortable or healthy in which a mass of cold dead air is allowed to exist in corridors and staircases.

It must be remembered that whenever the air in a house is warmer than the outer air, the house itself is in the condition of a large, and therefore very powerful, shaft, in which the tendency of the warmed air is to rise and draw in to the house air from the outside: hence, unless there is an arrangement provided for admitting fresh air into a house, air will be liable to be drawn into it from places where it may have been impure, and especially through the sinks and drain-pipes. As a provision against this danger, fresh air should be admitted into the body of every house, and especially into houses supplied with heating apparatus.

It is not sufficient that the air should be brought in from the outside, without precaution as to whence it comes; there are many causes of impurity in the vicinity of houses, and great care should be taken to bring the air from places where it cannot be contaminated by impurities. The comfort of the house in winter requires that the air so admitted be warmed.

Each building requires special treatment in the matter of warming and ventilation, according to the conditions of its position, its design, its uses, its construction, &c.; and the question as to the means by which the heat should be supplied, and as to the special arrangements for supplying it, are all matters which must be decided separately for each case.

The most economical method of warming a house in the first installation is probably by hot air from a central stove or *calorifère.* In this case, the air may be heated by a cockle, such as has been long in use in this country, and of which a new form is suggested by Mr. Reck; or the air may be warmed by hot water circulating through a number of pipes as designed many years ago by Mr. Sylvester.* The advantages of these are that the hot water in a large boiler forms a reservoir of heat, and that slight variations may be allowed to occur in the state of the fire without any sudden change in the warmth of the air supplied, whereas when the direct heat of an iron stove is used the temperature of the incoming air may be subject to rapid fluctuations.

A fire-brick stove also has the advantage of retaining the heat for some time, but then it does not part with its heat with sufficient rapidity to enable it to warm so large a body of air as would be required in a large house unless it were of an undue size.

---

* It is supposed that Messrs. Rosser and Russell continue the business which Mr. Sylvester originated.

Warmed air supplied from a central source as a means of heating should be supplemented by open fires in the rooms. When it is desired to warm a house without open fires, then it is probable that more comfort would be found in the use of hot-water pipes or steam-pipes in the several rooms. As it is impossible to lay down rules which can meet the very varying circumstances which arise, it has been the object of this Handbook to explain the several points which should be considered by persons desiring to adopt some system of heating their houses rather than to define any particular system.

LIGHTING.

Every form of matter when sufficiently heated has the power of emitting rays of light, and thus becomes self-luminous. This condition is termed incandescence.

All artificial sources of light depend upon the development of light during incandescence. For the purposes of lighting our streets and houses we have hitherto chiefly made use of a combustible gaseous combination of carbon and hydrogen, which forms the chief constituent of ordinary coal gas. When this hydro-carbon burns, that is to say, when its elements unite with the oxygen of the air, it undergoes partial decomposition and evolves heat. Carbon is separated in the solid state, and floats in a finely-divided and incandescent state in the interior of the burning vapour, and this constitutes the flame. The presence of these particles of carbon may be easily shown by holding any non-combustible body in the flame, when the carbon, in fine powder, will be deposited upon it, forming a layer of soot. The combustion of the particles of carbon takes place at the border of the flame, where they are first brought into contact with the oxygen of the air; but if the supply of oxygen to them be insufficient in quantity, they escape in a partially unburnt condition in the form of a dark cloud;

and the flame is said to smoke. The brightness of the flame is owing to these solid incandescent particles, for the burning gas itself possesses only a feeble illuminating power. The Bunsen burner gives a smokeless and non-luminous flame. In the Bunsen burner ordinary gas conducted through india-rubber tubing streams into the tube of the burner. Air enters, however, and mixes itself with the gas in the interior of the tube. If the mixture issuing from the tube be ignited, it burns with an extremely feeble flame which deposits no soot on bodies held in it. Oxygen is admitted not only to the border of the flame, but throughout its whole mass, and the carbon is accordingly burnt into carbonic acid before it can separate in the solid form, so that the flame is composed of incandescent gases alone. The feeble luminosity of the Bunsen flame appears to be due, first, to a rapid oxidation, by means of the oxygen in the admixed air, of luminiferous material to gases of feeble illuminating power; secondly, the diluting gases reduce the illuminating power; and, thirdly, heat is withdrawn by the indifferent gases, as nitrogen, and the products of combustion, carbon dioxide, and water. In consequence of the more perfect combustion that takes place, it is used as a heat-producing flame. If a solid body be introduced into this feebly luminous flame, such for instance, as a piece of platinum wire, the incandescent metal glows with a brilliant light.

The flames of candles and lamps, whether the substance burnt be tallow or wax, rape-oil or petroleum, do not differ essentially from that of an ordinary gas-burner. The same hydrocarbon gas which is the essential constituent of common gas, is the source of light in them. The hot wick which draws up the fluid material about to be burnt, plays the part of a small gas factory, the produce of which is used on the spot, the only difference being that coal-gas is always purified before it is consumed, whereas the extemporaneous gas of a candle or lamp is consumed without being purified at all; on the other hand the tallow, wax, and oil, contain the carbon and hydrogen in a purer and more concentrated form than the coal from which ordinary coal gas is made. The flames of candles and of lamps all owe their luminosity to the incandescence of particles of carbon floating in them; and the reason why one description of candle or lamp is more smoky than another is because the supply of air in the smoky one is not sufficient to produce adequate combustion.

A petroleum lamp burns, in the first instance, with a dull murky flame, giving off a large quantity of smoke, but it acquires a high degree of luminosity when the glass chimney is applied, for the presence of the chimney causes a strong draught, supplying the air requisite for the thorough combustion of the gas with which it was previously insufficiently intermingled. The brilliancy of a petroleum flame is thus materially exalted by an increased supply of air, whilst that of a Bunsen's burner, as has just been seen, is almost abolished by the same means. The contrary effects observed in these two cases admit of easy explanation. In the latter instance the amount of air supplied is so great that scarcely any of that separation of the particles of carbon takes place, which is so necessary in order that a bright light should be produced. But in a petroleum lamp, the introduction of a moderate quantity of air, by effecting the combustion of the superfluous particles of carbon, causes a higher degree of heat, and consequently a more lively incandescence and illumination of the still remaining particles.

From this it is obvious that, in order to obtain the highest illuminating power of a flame in which hydrocarbonaceous compounds are undergoing combustion, the regulation of the supply of air is essential. This more perfect combustion is also essential to the maintenance of the purity of the air of the room.

In a hygienic aspect, it is also essential that the compounds used to produce light should be as pure as possible, and during the last twenty years vast improvements have taken place in the methods of purifying gas, so that now the London gas is almost entirely free from sulphur and its compounds. The effect caused on the air of a room by combustion is (1st) to diminish the oxygen, and (2nd) to increase the carbonic acid and to produce water and ammonia. If the combustion is imperfect, the effect is also to create carbonic oxide and soot, as well as to disperse into the room any impurities which the material which is used for illumination contains, besides the carbon and hydrogen which is necessary for purposes of illumination.

If we look back at the gradations of improvement which have taken place in artificial lighting, we find that each successive step has been of advantage to the purity of air. Probably the earliest known means of lighting was the *torch*, cut from the pitch-pine, and sticky with exuded resin. It gave a red large flame, and volumes of smoke which condensed into small particles of soot, which adhered to faces and clothes with surprising determination, and may give some idea of the eminent discomfort experienced in a hall lighted, like the Walhalla, with pine splinters. Substituting a rope for a splinter, and saturating this with pitch or resin, we have the *link* that still, on foggy days, connects us with the past.

The lamp of the type found in Pompeii probably succeeded these cruder means of lighting. The wick of oakum, or flax, or cotton, dipped in oil or bitumen, gave a smoky flame because no effort was made to bring a sufficient current of air to the wick to assist the combustion.

The argand burner with its chimney, and the air brought so as to increase the combustion of oil-lamps, was a great step in advance, and effected a most marked improvement in the purity of the air of a room.

Candles with a wick made of the pith of rushes and covered with wax or tallow, are mentioned by Martial and Juvenal. These must have resembled the smoky rushlight of our more immediate ancestors; and the tallow-candles which many of us remember as of yesterday, diffused impurities in the air far greater in proportion to the light they afforded than any modern form of light. The last fifty years have witnessed vast improvements in the wicks and in the materials of candles, so that their smokiness has been gradually much reduced. Indeed, as regards the contamination of the air of a room, it may be accepted as an axiom that the more imperfect the combustion in any source of artificial light, the more deleterious the effect on the air of the room. We complain of gas, but if we were satisfied with the same amount of light in the case of gas which we obtain with candles or lamps, and if we took care that all the gas passing through the burner was thoroughly consumed, we should not find the vitiation of the air more inconvenient with one than with the other.

Indeed, it may be assumed that the atmosphere of a confined room lighted by cannel gas would support life twice as long as the atmosphere of the same room lighted equally by tallow-candles. Nor does the complaint that is frequently made of the heat of rooms lighted by gas afford a much better foundation for an objection to gas-lighting than its assumed insalubrity. The fact may be true that a room lighted by gas is hotter than when lighted by candles, but the cause is to be attributed not to the greater heat-giving power of the gas, but to the greater illumination when gas is employed. If persons, when burning candles, would increase the number of the candles so as to equal the light of the gas-flame, the heat given out would be found to be less when burning gas than when burning lamps or candles. It has, indeed, been proved by experiment that the combustion of colza oil produces nearly twice as much heat as the flame of cannel gas of the same standard of luminosity, and that in comparison with ordinary 13-sperm-candle gas the proportionate amounts of heat are as 78 to 68. A room lighted by a large moderator lamp burning colza-oil is perceptibly heated quite as much as by a gas-flame that gives a larger amount of light.

The conditions which affect the purity of the air of a room are, however, not all the same in the case of lamps or candles as those which prevail when gas is used. In the case of the lamp or candle, the wick either draws up the hydrocarbon on which it depends for its light by capillary attraction, or else this hydrocarbon is forced up the wick at a uniform rate by an equable pressure.

In a hygienic point of view the greatest improvement which took place in oils for lighting was the introduction of mineral or hydrocarbon oils, together with the improved methods of admitting air to the wicks.

These oils are little more than gaseous hydrocarbons condensed into a liquid form, and capable of being brought into the state of gas or vapour by a certain elevation of temperature. The resulting gas or vapour precisely resembles coal gas in this, that if mixed with a certain proportion of atmospheric air, it will explode when brought into contact with flame, or with incandescent material of any kind.

The applicability of these oils for burning in lamps is dependant upon the temperature at which they take fire, or give off inflammable vapour. The temperature at which the vapour given off by a sample of oil takes fire by contact with a flame, or the "flashing-point" of the oil, lies a few degrees lower than that at which the oil itself takes fire and continues to burn.

All the valuable properties of petroleum as an illuminant are afforded by the ordinary oil of commerce, which is sold for the purpose of burning in lamps, and which is always to be procured at the market price of the day.

The risks incidental to the use of petroleum oil are—first, explosions; secondly, fires. And to obviate these risks an Act of Parliament prohibits any petroleum oil from being sold by retail which has its flashing-point below a temperature of 100° Fahrenheit.

In order to obtain complete combustion of the petroleum, in the best lamps the admission of air to the flame is regulated from below, and the draught is obtained by the use of a chimney.

Silber has done as much as, if not more, than any one to perfect these and other oil lamps. Mr. Brudenell Carter, in a paper in "Our Homes," gives the following as the approximate cost of candles and oil light.

The best candles are the so-called "sperm," which are used for testing the quality of gas under various Acts of Parliament, and each of these candles consumes an average of 120 grains of fuel per hour. The average cost of sperm candles is 2*s.* 6*d.* for a pound weighing 7000 grains.

Let it be supposed, as a basis of calculation, that a uniform light of twenty candles is required for a period of 100 hours. The cost of obtaining it by different forms of fuel would be as follows:—

Twenty sperm candles would burn 2400 grains per hour or a total of 240,000 grains. This amount, divided by 7000, the number of grains in a pound, gives 34·28 lbs., or a cost of 4*l.* 5*s.* 9*d.* Ozokerit candles, which cost a shilling a pound, would yield the same result for 1*l.* 14*s.* 3*d.*

Colza oil, burned in moderator lamps with Mr. Silber's burner, is consumed, according to the experiments of Professor Valentin, at the rate of 49 grains for each candle-light per hour. This would give, for twenty candles for 100 hours, a total consumption of 98,000 grains, or an expense, reckoning 9 lbs. to the gallon, and 3*s.* 6*d.* per gallon as the price, of 5*s.* 5*d.* Ordinary moderators consume 65 grains per candle-light per hour; and with them the cost would therefore be 7*s.* 2*d.* for the same result.

Petroleum oil, also, when burned in Silber burners, is consumed at the rate of 48 grains per hour for each candle-light, so that 84,000 grains would be required for the twenty candles for 100 hours. This, at 1*s.* 4*d.* per gallon of eight pounds, would cost 2*s.*

As between the solid and liquid fuels, therefore, candles are a very costly luxury when compared with colza oil, and this again is two and a-half times the price of petroleum.

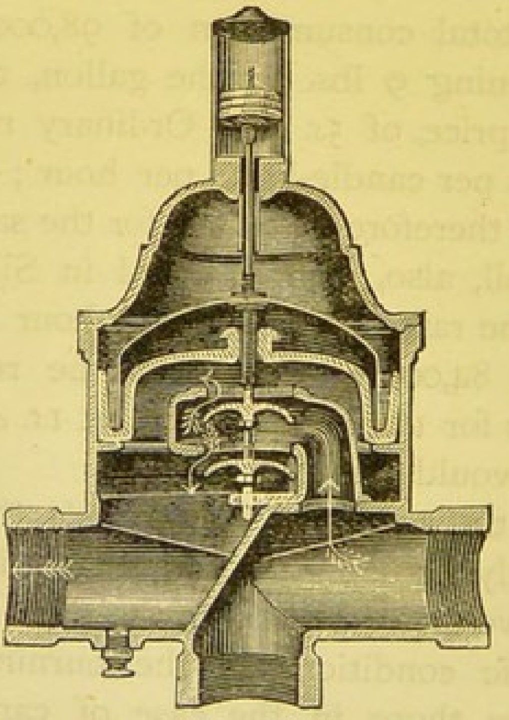
The hygienic conditions in the burning of gas differ somewhat from those in the case of candles. The gas comes from a street main, in which the pressure is constantly varying, partly in consequence of the continual variation which takes place in the number of lights in use. For instance, if a large shop suddenly lights up its establishment, a sudden decrease of pressure would occur in the neighbouring houses; in order to obtain sufficient light in a neighbouring house, it might be necessary to turn the cock of the burners full on. When the lights in the shop were extinguished, the pressure would be suddenly increased, and the gas would be forced through the burners more rapidly than it could be consumed. Consequently much impurity might be forced into the house in the shape of unconsumed gas.

It is therefore necessary to regulate the pressure at which the gas reaches the burners, and many of the complaints of the impurity of the air of a room, caused by gas, arise from this want of regulation of pressure.

The pressure can be regulated by the use of a governor placed either at the meter or in proximity to the light itself.

The annexed sketch (Fig. 29) shows a section of Stott's Automatic Gas Governor, which received the prize at the Crystal Palace Gas Exhibition in 1883. The object of this governor is to prevent over-pressure on gas-jets and the waste of gas and consequent injury to the air of the room, by affording an unvarying outlet-pressure, though there

Fig. 29.



may be a varying inlet-pressure. A thin inverted cup or float, made of Barff's anti-corroding iron, dips into an annular porcelain trough of mercury formed with an inner shield for preventing loss of mercury, whatever may be the position of the instrument. The inverted cup is fixed on a vertical spindle, on the lower end of which a double-beat valve, having discs of equal diameter, is fixed, and on the upper end of which are placed weights by which the valve is loaded. The pressure of the gas admitted by the inlet-pipe acts upon the inner surface of the cup. The cup, therefore, rises when the pressure of gas is augmented, and by the same movement the double-beat valve proportionately closes the thoroughfare for gas through the instrument, and, by wiredrawing the current, prevents the outlet-pressure from rising. When, on the contrary, the inlet-pressure falls, the cup falls, and the valves are opened wider; a proportionately larger current of gas is allowed to pass, and the outlet-pressure is prevented from falling.

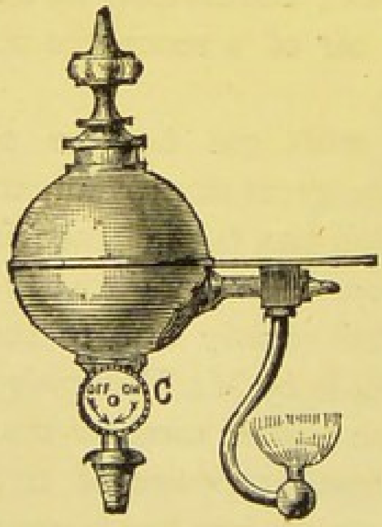
From these various considerations it is apparent that the more perfect the combustion is in artificial light, the less will it affect the purity of air in a room; but so long as the light is burned in contact with the air of a room, the air will be more or less affected.

Various efforts have been made with gas burners to improve the combustion, and indeed the great improvements in the illuminating power of gas which has taken place in late years, and has been announced from time to time at the various testing stations, appears to be mainly due to the burners. For instance, experiments made by Mr. Humpidge showed that a gas which, tested by the burner used for that purpose before 1860, gave an illuminating power of 10·5 candles, afforded, with the improved more modern test burner, a light of 14·5 candles. The improvements largely depend upon regulating the pressure at which the gas is delivered, so that it shall not pass unconsumed through the burners; but they also depend upon the temperature of the flame of the gas, and upon the proportion of particles of matter which can become incandescent which it contains. For instance, the influence of temperature is shown by the fact that the union of the flames from two gas burners produces a brighter light than the two gas burners would give if the flames were separate.

Various efforts have been made to increase the illuminating power of coal gas by enriching it with the vapours of hydro-carbons. The Albo-Carbon Light Company and the Omega Light Company have each exhibits intended to effect this enrichment of the gas in different ways. The effect of the use of additions to the illuminating power of coal gas may be best illustrated by the experiments recently made by Mr. D. K. Clark, in connection with the Gas Institute for the Jury * of the Crystal Palace Gas Exhibition of last year, upon the Albo-Carbon Company's exhibits.

The apparatus of the Albo-Carbon Company is constructed for the use of solid naphthaline, the gas supply being led through this vessel on its way to the burner. The heat developed in the combustion of the gas is employed for heating the naphthaline reservoir; and the amount of naphthaline taken up by the coal gas is a function of the temperature of the apparatus. Ordinary flat-flame burners were employed in the various forms of apparatus.

Fig. 30.



It appeared from the experiments that in ordinary working it required nearly fifty minutes for the apparatus to attain its full temperature and consequent efficiency.

The following Table of experiments made with a single flat-flame Albo-carbon burner shows generally the results obtained:—

---

* The jury consisted of Dr. Russell, F.R.S., Mr. Harris, and Captain Douglas Galton, F.R.S.

	Consumption of Gas per hour, in cubic feet.	Consumption of Naphthaline per hour, in grains.	Average Illuminating Power, in candles, during Experiment.	Illuminating Power of Gas if burnt alone, and giving a duty of 2·8 candles per cubic foot.	Illuminating Power, in candles, given by the Naphthaline.	Quantity of Naphthaline, in grains required to give a duty of 1 candle per hour.	Time occupied in the Experiment.	Pressure of Gas.
Mean of three Experiments . .	3·4	119·0	20·0	9·5	10·5	11·3	30	1·1
	3·4	172·1	23·2	9·5	13·7	12·6	60	1·3
	3·6	221·6	27·2	10·0	17·1	12·9	90	1·5

From the Table it may be assumed that after the burner has been lighted for a sufficient time, one cubic foot of gas supplied with naphthaline will give a light of 7·5 candles, but that the same burner unsupplied with naphthaline will only give a light of 2·8 candles. Consequently, by means of the union of gas and naphthaline, the same amount of light will be produced with only two-fifths of the amount of gas required if gas without naphthaline were used; but of course, in order to ascertain the relative expense of the two methods, it is necessary to add the cost of the naphthaline to that of the gas. The hygienic value of the arrangements consists in the diminished quantity of gas required to produce the same illuminating effect as is required with ordinary gas, but great care is required to ensure perfect combustion, otherwise there would be not only smoke, which of itself would be a serious evil, although being visible it could be guarded against; but with imperfect combustion there would be a liability to other products of the combustion of the naphthaline, which are not visible, being disseminated in the atmosphere of the room. It is therefore only upon the condition that perfect combustion is maintained that lights of the description of the Albo-Carbon Light can be considered to present a hygienic advantage.

For country houses, detached railways stations, and other small places where there may be trouble or inconvenience in fitting up an apparatus for making coal gas various machines for making what is called air gas have been suggested. These may be generally described to consist of a fan or pump arranged to force atmospheric air through some form of petroleum oil, or into a receptacle containing fumes of that oil. The air during its passage through the oil, or the fumes of oil, takes up a proportion of hydro-carbonaceous matter. One of the most effective apparatuses for this purpose is made by Messrs. Clark. In this apparatus the petroleum oil or gasoline, as it is termed, flows through a small pipe and drops into a copper retort, which is heated; eventually after the gas begins to be made the heat is derived from jets of the gas itself. The gasoline is thus subjected to destructive distillation, and mixed in the fan with air, with which it combines to form gas which is of a high illuminating power. Of course the pipes along which the gas is conducted must be kept warm, or else the gasoline might be again deposited.

The gas in ordinary use, however, is coal gas, and the most practical methods which have been devised for combining the purity of air in a room with artificial light produced from ordinary coal gas, may be classed under four heads:—

1st. The sun burner, in which the products of combustion are removed rapidly from contact with the air of the room.

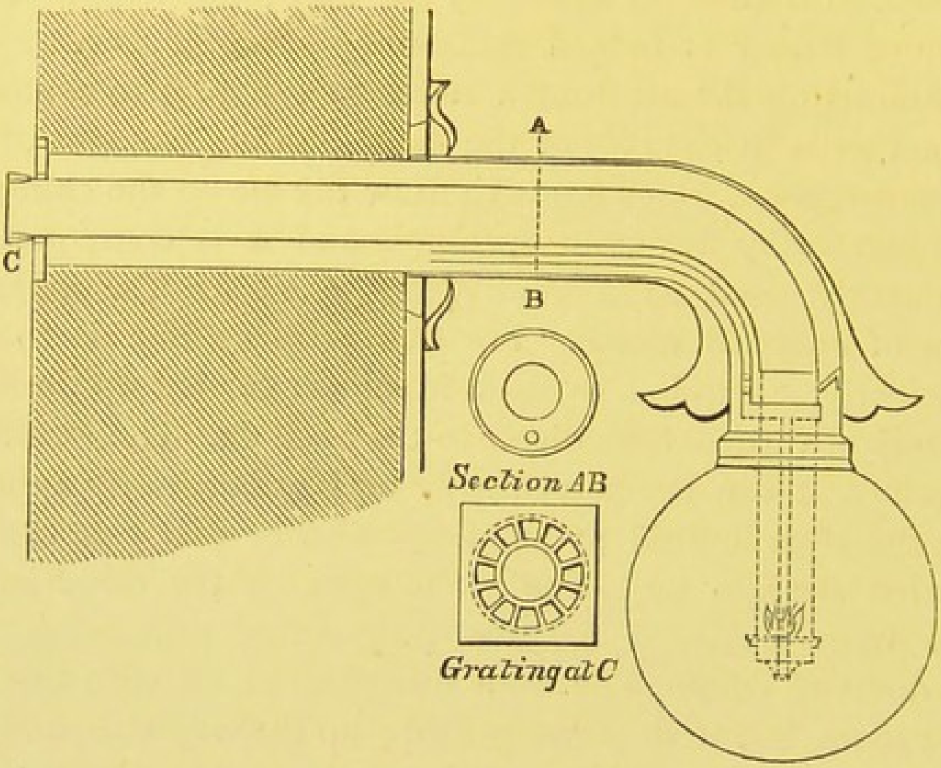
2nd. The globe light, in which the fresh air is supplied and the products of combustion are removed to the outside without any contact with the air of the room.

3rd. The regenerative gas light.

4th. The incandescent gas light.

The sun burner has been in use for many years. It is practically a powerful ventilator, which, by means of the great heat generated, draws a large volume of air away with the fumes of the gas, and thus it relieves the air of the room of the impurities caused by combustion, and at the same time removes other impurities which may be generated from other causes in the air of the room. This form of burner is indeed sufficiently powerful as a means of extracting the air from a room to enable it to continue to act even in the face of the counteracting draught of an open fire-place, which tends to draw the air up the chimney through every available opening; and it is consequently frequently used as a ventilating agent for the ventilation of crowded rooms. For this purpose, if it is to act efficiently, it requires to have its fumes carried up through a straight vertical tube direct to the open air. The localities in which it can be conveniently and satisfactorily applied are therefore limited to buildings whence this pipe can be carried straight up. The globe light, on the other hand, has been designed for the purpose of preventing the products of combustion from mingling at all with the air of a room, but it does not provide in the way the sunlight does for the ventilation of the room at the same time. The principle of the best form of globe light is that it should be burned in a glass globe entirely separated from the air of the room; that is to say, that the air required for supporting combustion should be brought into the globe from the outer air, and the products of combustion should be carried away into the outer air without mixing with the air of the room. One form of this arrangement is shown in Figure 31. Another form would be to admit the fresh air below, and to carry off the products of combustion at the top. This form of light, as in the case of the sunlight, is limited in its application. It can be applied near an outside wall, or else in a room which is directly under a roof. If fed with fresh air from the room itself, and if a fire-proof flue were constructed in the ceiling leading into a vertical flue, this form of light can be placed in any part of a room; but in a room with an open fireplace, the counteracting effect of the draught in the chimney from the open fire would be very likely to draw back into the room the products of combustion from such a form of globe light.

Fig. 31.



The regenerative gas-burner claims to be a hygienic invention, in that it produces a more perfect combustion, and diminishes the quantity of gas necessary to produce a given quantity of light.

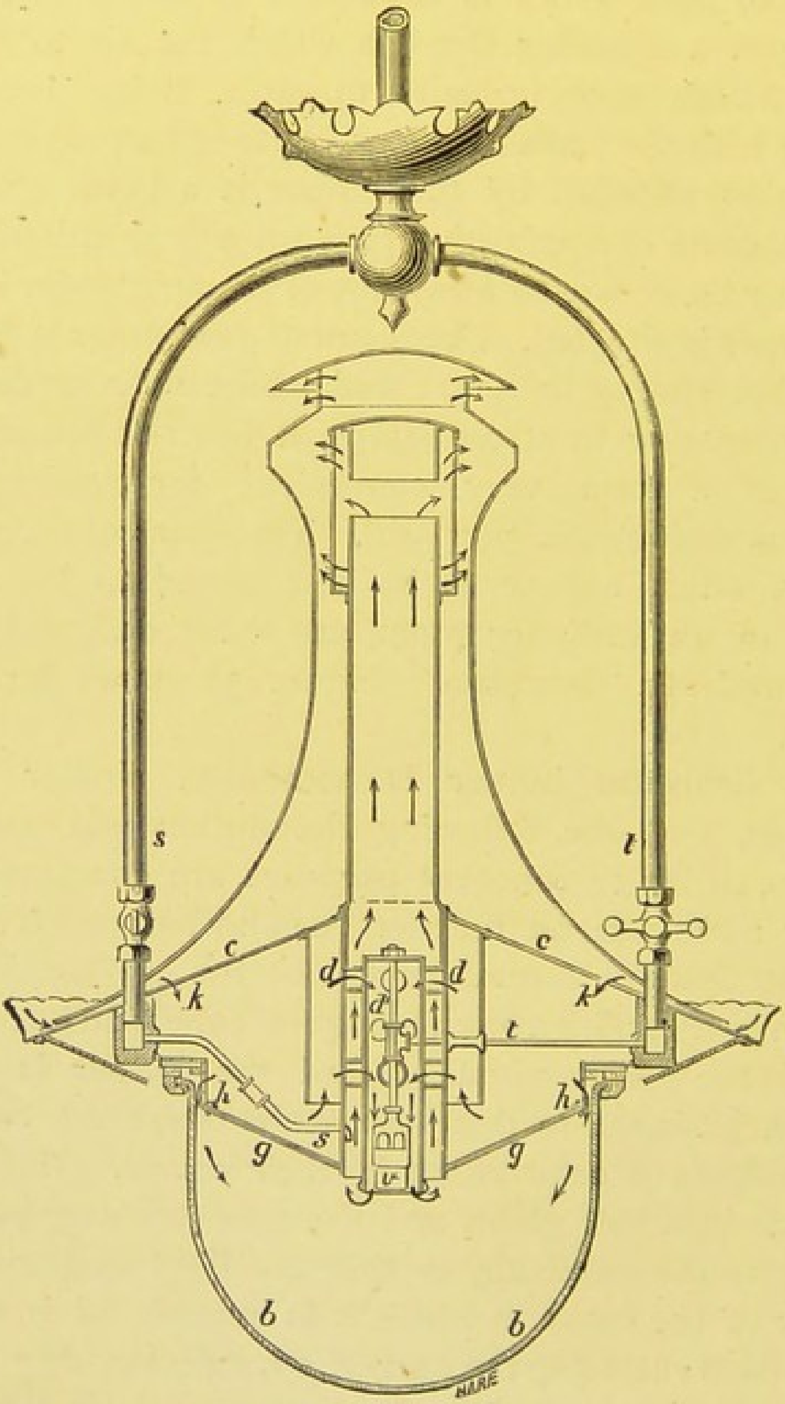
The globe light, as shown in the drawing, may to some extent be called a regenerative gas-burner, because the air for combustion is supplied to the flame after being warmed by its passage round the tube which conveys away the outflowing products of combustion. But the Siemens regenerative light was the first which can be termed practically a regenerative burner. As an instance of the advantage of the regenerative gas-burner it may be mentioned that the Siemens burner, exhibited at the Gas Exhibition of the Crystal Palace, which consumed, however, from 80 to 90 cubic feet of gas per hour, gave a light equal to nearly

8 candles per cubic foot of gas burned, whereas, with ordinary burners from 3 to 4 candles per cubic foot of gas, would be considered a good result.

The Siemens regenerative burner is an Argand burner, the flame from which is conducted centrally downwards, and heats a chamber through which the air to feed the flame travels concentrically upwards, being heated by contact with the walls of the chamber in its progress. The ventilation afforded by the burner is a great advantage. The products of combustion pass up a long chimney tube, and may be conveyed away out of the apartment in which the burner is situated. The Siemens gas-burner is, however, somewhat clumsy in form ; and whilst very applicable to large spaces or to street lamps, it has not hitherto been made of a form very convenient for moderate-sized rooms and domestic purposes. The forms of regenerative burners which appear to be best suited to the requirements of an ordinary room, are those designed by Mr. Clark and Mr. Grimston. Figure 32 shows Mr. Clark's burner.

The Grimston burner is somewhat similar in construction, and the following description will suit both burners, so far as practical purposes are concerned. The burner looks like an inverted Argand burner. The gas is brought down a central tube, and the products of combustion are carried away through a tube which lies round it, and the air required to feed the burner is brought through passages in this latter tube which are heated by the products of combustion in their course. The light is enclosed in a half globe, and the products may be carried away into the outer air, so that the light need not injure the air of the room in which it is burned. *b* is the glass hemisphere enclosing the burner, *g* a reflector, *d* the passage for heated air supplied to the burner, and *h* apertures for cold air passing along the inner surface of the glass hemisphere to keep it cool. The products of combustion pass away along the upright tube as shown by the arrows. A very remarkable feature about these regenerative arrangements is that the temperature of the outflowing products of combustion at the top of the tube is so low that the hand can be held over the top of the tube without any

Fig. 32.



unpleasant sensation of heat; and the combustion appears to be so perfect that even if the products are not removed from the room, the hygienic value of this burner is superior to that of ordinary gas-burners.

The photometric value of these burners is considerable. The experiments made by the Gas Institute for the Judges of the Crystal Palace Exhibition showed the following results. The Clark 5-foot recuperative gas burner, consuming 5·32 cubic feet of gas per hour, gave a light of 4·76 candles per cubic foot of gas, whilst the best Argands, or flat-flame burners, experimented on gave from 3·13 to 3·63 candles per cubic foot of gas; and the Grinston 10 foot recuperative burner gave 5·29 candles per cubic foot of gas. These burners are quite a new development of gas-burners, and deserve the attention of all persons desirous of combining a pure atmosphere in the room with plenty of light.

Another adaptation of the principle of the Globe gas-light is the Schönheyder sanitary stove, which combines the warming of a room with a gas-light. This has been shown at Fig. 21.

The products of combustion are carried to the outer air, and in their passage the heat they contain is used for the purpose of warming fresh air which passes into the room. Mr. Schönheyder, by this ingenious invention has solved the problem of not only brilliantly lighting a room, but also of getting rid of the products of combustion, and utilising them in a most scientific manner to warm and ventilate the apartment.

The next form of burner to which it is desirable to call attention is also very novel, although based upon the application of well-known natural laws. The illuminating intensity of a glowing body increases in a greater ratio than the temperature. Moreover, the heat which is developed by the combustion of gas is out of all proportion to the small quantity of hydro-carbons contained in it, and which, by their dissociation and the setting free of the carbon particles, are the source of light produced. It has been even alleged that the energy contained in gas can, by being converted into motive power and electricity, be made to produce more light than when burned direct from an illuminating burner notwithstanding the loss which occurs in converting the heat of combustion first into motive power, then into electricity, and then into light. It is therefore evident that a much greater amount of light could be obtained from gas, if the heat-development of combustion were better utilised. Acting upon these principles, Mr. Clamond has constructed a lamp. The Clamond lamp is nothing more or less than the Drummond lime-light made practically useful. Instead of using oxygen, he uses atmospheric air, and instead of the zirkon, or lime cylinder, he uses a network of magnesia. Oxygen can in almost all cases be replaced by air, if the latter be strongly heated. Clamond therefore heats the air before it reaches the burner, and obtains a similar effect to that of oxygen. It is not, however, easy to heat air to a high temperature whilst it travels a short distance; moreover, the volume of air passing to the burner is six times that of the gas, and the heat-conducting power is small. In the construction of his burner, Clamond causes the air to play upon every part of a fire-clay tube, which is heated externally by the combustion of the gas. A pressure of 200 millimetres of water (7·8 inches) was at first necessary to force the air through this tube, but by improving the construction of the burner, a pressure of 35 mm. (1·37 inches) is now found sufficient. In consequence of the large volume of air which is required, and of the pressure which is necessary to bring it in contact with the material for heating it, the air is delivered at a pressure through pipes laid by the side of the gas pipes to the burner. The "wick," as the conical basket-shaped network of magnesia is called, which is heated by the flame to incandescence, is very cheap, and will last for about forty hours, so that it is only necessary to change it once a week, and it is easily replaced. It is supported by two crossed platinum wires, which are fastened to a brass ring having a bayonet joint. The light given by the glowing magnesia basket is perfectly steady, and of an agreeable yellow tone. If the wick be used longer than for forty hours, the light becomes bluish in colour, and approaches that of the Jablochkoff candle. Also by further use a portion of the magnesia is consumed away, but the small quantity of white dust thus produced is not at all unpleasant or harmful. The magnesia basket is situated at the bottom of the burner to prevent shadows, but the burner can work in any other position, and the light can be regulated by a tap to any desired intensity. The burner is made in two sizes. One size consumes 180 litres (6·3 cubic feet) an hour, and gives a light of 4·15 carcels (about 37 candles), that is to say, nearly 6 candles per cubic foot of gas; the other size consumes 500 litres (17·6 cubic feet), and gives, it has been stated, a light of 18 carcels (about 162 candles). This would be equal to 9 candles per cubic foot of this form of light. These are larger burners than appear to have been tested in England, and the result requires to be verified.

The experiments made by Mr. D. K. Clark in connection with the Gas Institute for the Jury of the Crystal Palace Gas Exhibition of last year, on small burners of this form, consuming about 7 cubic feet of gas per hour, showed a duty of 4·26 candle light per cubic foot of gas, without reflectors, which for small sized burners is high.

It is, however, to be remarked that the ordinary illuminating power of the gas has nothing to do with the light of these incandescent lamps; it is the heat of combustion alone that produces it. It therefore follows that it is a matter of indifference whether gas of greater or less illuminating power be used. It would not be necessary with this burner to use gas-coals, but cheap coal might be used, and the cost of production considerably reduced. This burner requires that the air should be supplied to the burners through tubes from a pump; the air ought to be at a high temperature, and therefore should be applied on the regenerative principle. The light thus requires a degree of adaptation which is unnecessary with more simple burners; and, moreover, the necessity of replacing the magnesia basket every three or four days is to some extent an inconvenience.

A somewhat similar burner has been devised by Mr. Lewis, but instead of using a magnesia basket as an incandescent medium, he adopts a basket made of platinum. The gas is mixed with a large volume of air under pressure before its point of combustion, and the heat thus generated by what is practically a Bunsen burner, produces the incandescence of the platinum. The platinum ought to have the advantage of durability as compared with the magnesia; but there is the objection to platinum, that unless the combustion of the gas is very perfect, the carbon in the gas may cause the destruction of the platinum-basket, and this occasionally happens.

These incandescent lamps, even if burned in contact with the air of a room, present certain hygienic advantages. In the first place, the air required for combustion is brought into the room from the outside, in the proportion of six volumes of air to one of gas, and therefore the oxygen in the air of the room is not consumed for combustion. In the second place, the gas is consumed in a very perfect manner, so that the injury to the air of a room produced by the combustion is reduced to a minimum. These lights could be placed in any part of a room where ordinary gas-lights can be placed, and it is probable that from their hygienic and photometric value this class of light is destined at no distant date to replace ordinary gas-burners, to the great advantage of the purity of the air of a room.

Mr. Brudenell Carter stated that the cost of gas, as compared with the cost of oil already mentioned, is as follows:—

"Gas in London costs about 3*s.* 4*d.* per thousand cubic feet, and we have seen that this gas, when burned in the tubular argand of Mr. Silber, or in the argand burner of Mr. Sugg, which is nearly as good, affords a light equal to that of 18·6 candles for a consumption of 5 cubic feet per hour. It follows that the light of 20 candles for 100 hours would be afforded by a consumption of 537 cubic feet which would cost 1*s.* 9½*d.* The best of the flat-flame burners gave 16·2 candle-light for the consumption of 5 cubic feet of gas; so that for 20 candles for 100 hours the consumption would be 617 cubic feet, at a cost of 2*s.* 0¾*d.*"

There is one matter in connection with gas-lighting which has not received the attention which it deserves, viz., the use of reflectors. Lamps, both out of doors and in rooms, could be rendered very much more efficient by means of reflectors carefully arranged to cause the rays of light to be thrown in the direction in which they are most wanted.

The next form of light to which it is necessary to call attention is the electric light. The luminosity of the electric light is due to incandescence, as is the case with other forms of light mentioned. In the case of the ordinary electric light, the carbon points brought into apposition become intensely incandescent at the points of contact, and these points can then be withdrawn for some distance from each other without interrupting the current or the light it produces. Between the carbon points an arc of glowing particles of carbon appears, the so-called Volta's arc of flame, which effects the conduction of the current at the point of interruption. This flickering arc of flame is far less bright than the carbon points themselves; the particles of carbon of which it is composed detach themselves from the positive pole, which is the hottest of the two, and fly across to the negative pole. As a result of this, after a short time the positive pole becomes shortened and even excavated, whilst the negative preserves its pointed form. At the same time, combustion of both poles takes place to a certain extent, owing to the action of the atmospheric air; and the positive pole, which is exposed to the destructive action of two agents, is more rapidly consumed than the negative.

The electrical arc-light, with its dazzling brightness, is subject to fluctuations, from the fact that the carbon-points are continually wearing away; and the constant necessity for shifting them renders the arc-light often unsteady.

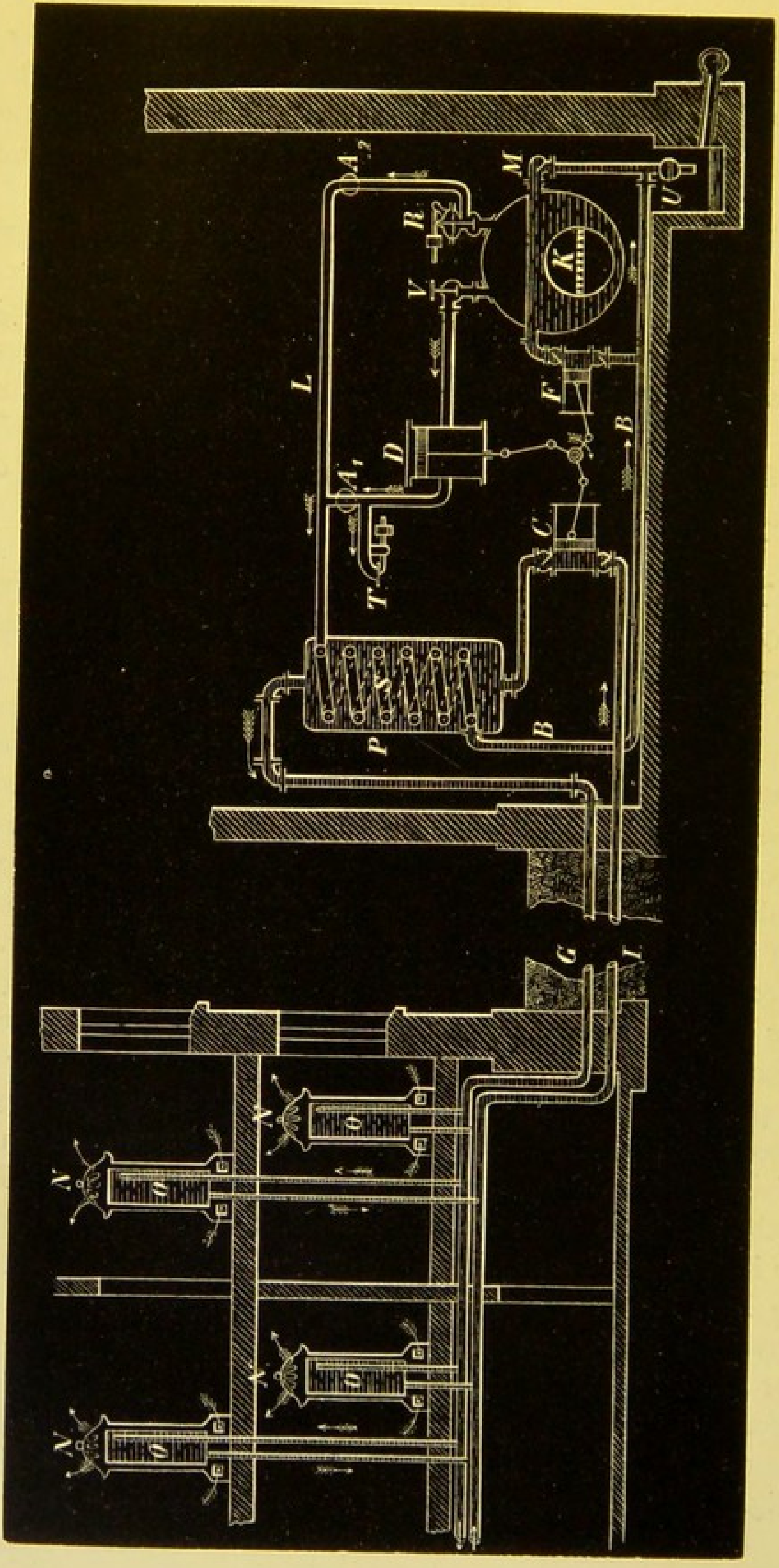
Moreover, it is not pleasing in colour; and it has been alleged against it that it produces a notable quantity of nitric acid, and is thus inimical to the purity of the air in a confined space.

Another form of electric light has therefore now superseded the arc light for rooms, viz., the incandescent light, as made by Swan, Edison, Wodehouse & Rawson, and others. In this form of light the electric current is employed to heat a thread of carbon so as to make it incandescent, and thus to use it as a source of light. For this purpose the carbon is enclosed in a glass globe, from which the air is extracted, in order that there may be no oxygen to unite with the carbon during incandescence and to destroy it. This form of light for rooms possesses none of the hygienic disadvantages of the arc light, and in a hygienic point of view is indeed the most perfect form of light which can be imagined. The light so obtained may be placed anywhere in a room; it is cut off from all contact with the air of the room, and therefore there is no possibility of the purity of the air being injuriously affected by it. The light is thus entirely independent of the ventilation. The various forms of incandescent lamps, whether the Swan, or the Edison, or the Woodhouse and Rawson, differ mainly in the manner in which the carbon is obtained, and in the nature of the carbon. The filaments of carbon in one case are derived from fibre of cotton, in another from bamboo. In the case of Messrs. Woodhouse and Rawson's incandescent lamp the filaments are made entirely of deposited carbon by a process which has the effect of producing a filament which is very hard and close. It is alleged that the filaments can be produced practically of any thickness required.

It is rather difficult to tell the efficiency of the lamps, as the element of time is of so much importance. Messrs. Rawson and Woodhouse at present guarantee an efficiency of 2¼ watts per candle power, with a length of life over a thousand hours. They state that the temperature at which, at present, they run the lamps is below the temperature of the "Swan" lamp; and they say that if they ran their lamps at such a temperature as would enable them to last only for a thousand or fifteen hundred hours, they might safely guarantee an efficiency of 1½ watts per candle power.

There is no doubt that we are at present only on the threshold of electric lighting. At the present time it can only be produced as a practical light by means of steam engines and dynamos; and it is thus applicable only on a somewhat large scale; it is to be hoped that some method of generating electricity may ere long be discovered which will enable it to be applied on a smaller scale to detached houses.

The secondary batteries for storage of electric power have done much in this direction by enabling electricity generated by a steam-engine to be stored for use as required; but for the supply of electric light on a large scale the first cost as well as the space occupied by these batteries, is very considerable; and indeed, even with these adjuncts it would scarcely be economical in separate establishments to employ steam for supplying electric light, unless it could be utilised in some way for other purposes. In large country houses, where a farm and a timber-yard often form part of the establishment, the power generated by the steam-engine could be transferred by electricity either to a saw-mill, to a chaff-cutting machine, or to a pumping-engine; and when not wanted for these purposes the electricity generated might be stored in a Faure accumulator for use in lighting the house. The exhaust steam from the engine might be employed either to heat water for circulation in hot-houses, or be employed to heat the house in winter; and at night the hot water from the boiler might provide for the necessary circulation for heating purposes. The late Sir William Siemens adapted the boiler of the steam-engine to heating his hot-houses, and applied the electric light to ripen the fruit. Fig. 33 shows an arrangement by which Mr. Reck proposes


A₂
R
V
L
A₁
D
T
K
M
U
F
B
C
S
P
B
G
I
N
O
N
O
N
O
N
O

to store heat from the exhaust steam by employing it to heat a reservoir of hot water. *K* is the boiler; *R* a reducing-valve supplying the necessary steam from the boiler, when more steam is required than can be got from the engine. *T* is a safety-valve letting out the surplus of exhaust steam if the engine supply more than required for heating. *A*, *A*2 and *V* are common stop-valves. The exhaust steam passes from the cylinder *D* to the coil of pipes *S*, by means of which its heat is transferred to the water in the tank *P;* and by means of a pump, *C*, this water is kept circulating from the tank *P* through the pipe *G* to the heating-coils *O* in the building, from which it again returns through the pipe *I* to the tank *P*. *F* is the feed-pump. The dynamo engine which supplies the electric current to the lamps is not shown in the woodcut.

By arrangements of this description the electric light might be obtained in a country house at a comparatively small cost. It is worth while to make some sacrifice to obtain a method of lighting our houses which will give us ample light without injuring the purity of the air. The incandescent electric light does this, and it is for this reason that, as hygienists, we should always prefer this form of light to any other. Although, however, it may be assumed as probable that eventually the electric light will supersede all others; we think that it may be predicted without much risk that the improvements which have been made in illumination by means of gas will probably enable that material to hold its own for some time longer as a lighting agent. There can be no question but that with the growth of our towns the use of gas will be largely extended for heating and cooking.

CONCLUSION.

The object of this Handbook is to explain briefly the principles which govern the ventilation, heating, and lighting, of our houses; and the descriptions which have been given of different sorts of apparatus are intended as examples of various ways in which these principles have been put in action, rather than to advocate the indiscriminate use of any special appliance.

The special arrangements which should be adopted in any house depends upon local conditions of site, design, and occupancy.

What is wanted is to obtain pure air in the house, and to effect this not only must pure air be admitted, but anything in the house which renders the air impure must be avoided. The impure air which is so frequently found in our houses exists there because the public does not appreciate the necessity of pure air.

There is now a general concurrence of opinion that bad water is detrimental to health, and vast efforts have been made to improve the water supply of our towns.

If the opinion was only equally spread through the community that bad air was detrimental to health ; if the fact of a room being close and stuffy was regarded as disgraceful ; if people refused to attend dinners or parties where the rooms were filled with bad air, the architect, the builder, and the occupier, would soon find means that in every room the air should be pure and of a comfortable temperature.

If the result of the Health Exhibition should not do more than impress strongly on the public the necessity of always maintaining pure air in our houses, His Royal Highness the Prince of Wales, to whose initiative the Exhibition is due, will have conferred a lasting benefit on the people of England.

INDEX.

Accidents, causes and extent, 465–486; from unfenced machinery, 469; from cleaning machinery when in motion, 469, 470, 473, 474, 475 tabular statements, 470, 471, 472, 473, 478; accidents from use of circular saws, 481; safeguards against accidents from machinery, 478–485

"Aërophor" (the), 579

Aitken, Dr. (Edinburgh), 555

Albo-Carbon Light Company, apparatus for use of solid naphthaline with gas, 624

Albright, Mr., patentee of amorphous phosphorus, 503

Ammonia, its presence in the air, 552

Ansted, Prof. D. T., 158

Antiseptics, their use in the sick-room, 147, 148

Army Sanitary Commission (1858), report of, 536

Assendon spring, 255

Atkins & Son (Charing Cross), filter for softening hard water, 240

Automatic Gas Governor (Stott's), 622

Baker, Mr., in reference to accidents from machinery, 477

Barracks and Hospital Improvement Commission, 566, 569

Basements of houses, should have comfortable rooms provided for servants, 304, 305; great importance of proper sanitary arrangement, 302, 303

Bath, temperature of the, 115

Bath-room, internal arrangement of, 336

Bedfordshire, 67

Bedouin tents, 20, 21

Bedrooms, 345–347; furniture of, 141; aspect, 138; isolation, 138; ventilation, 138–140; scrubbing with sawdust, 141; carpets, 141; warning against hanging up garments on walls and doors, 141; internal arrangements of, 338, 339

Benzole, 302

Bird, Mr. Hinckes, 541

"Blackman Air propeller" (the), 541, 542

Blackwell, Dr. Elizabeth, quotations from, 122, 123

Boyle's mica valve for ventilating flues, 175; ventilator, 575, 610, 611

Bramah, Mr., 219

Bruce, Mr. Knight, statement by, 78

Bryant & May, Messrs., 503

Buchan, Mr. W. P., 176

Buchanan, Dr., 82 ; as regards the chemical analysis of water, 232
Bunsen burner, 616

Camphine, 302
Candles (sperm), 302 ; stearic, 302 ; tallow, 302 ; wax, 302
Carbonic acid, its presence in the air, 562
Carpets in bedrooms, 347
Carter, Mr. Brudenell, 620, 634
Cesspools, 272, 273, 274, 275, 276 ; 193, 194 ; their abolition, 194, 197 ; in direct communication with houses, 195 ; common in towns in the olden times, 196 ; danger of opening old cesspools, 197
Chadwick, Mr., plan of occasional cottage, 38
Chapel Brampton, sewerage and water supply of, 44, 45
Child-bearing, as a natural process, 142 ; mortality of women at this period, 142, 143 ; elements of danger, 143
Child-bed fever, 147
Children, warning as to risks run at seaside and other health resorts, 108, 109 ; origin of acute disease in, 119
Chills, avoidance of, 110, 113 ; caution against draughts, 111 ; how caused, 120
Church Brampton, sewerage and water-supply of, 45–48
Cisterns and their construction, 234–238
Clamond, Mr., 632
Clark, Mr. D. K., experiments by, 633
Clark or Porter-Clark process for softening hard water on a large scale, 240
Closet, method of fixing hopper basin with waste preventer, 49
Clothes, importance of this subject in infancy, 118
Cohn, Dr. (Breslau), 395
Colne Valley Water Company's Works, 240
Combe, Andrew, quotation from, 102–104
Commissioners of Woods and Forests, 75
Congestions, how caused, 119
Cottage hospitals, arrangements for, 60–62
Cottage register, form of, 93, 94
Cottages, notes on registers of, 91, 92 ; plans of the Ecclesiastical Commissioners', 72 ; plans of the Duke of Northumberland's, 70, 71 ; principles of the plans of, 32–38
Craven, Mrs., 131
Crosley's ventilators, 175

Dampness, precautions against, 165, 166, 167, 310
Disinfection, apparatus for house, 176, 177
Dollfus Mieg et Cie., of Mullhouse, 479
Donegal, weaver's home in, 23
Doulton's German stove, 599
Drainage, as regards lying-in rooms, 143, 144
Drains, classification of, 181 ; brick drains, objections to their use, 181, 182, 183 ; appearance of rats, 183, 184, 185 ; undesirability of their being laid inside houses, 190 ; example of this, 190, 191 ; pipe drains, 187 ; proper method of using, 188 ; iron drains, means of protection, 189 ;

subject to galvanic action, 189; and abnormal local oxidation, 189; maxims to be observed in laying down drains, 191; object of inspection chambers, 192; patterns of air-tight covers for them, 192; use of rods in exploration of drains, 192, 193; disposal of old brickwork in drains, 193; modes of outfall deliveries, 193; cesspools, 193, 194; their abolition 194; connection with sewers, 197; use of "flap-traps," 198; disconnection of drains, 198; methods of effecting this, 198–201; flushing, 201, 333; description of Field's Annular Syphon Tank, 202; methods of flushing in use, 202, 203; drain testing, 203, 204

Draught, effects of, 310

Drinking-water supply, importance of complete separation from water-supply to closets, 233, 234; storage, 231

Dropsy, frequent cause of, 119

Dwellings, essential conditions of, 30, 31

Dyer, Mr. F. (Camden Town, London), system of heating soft water for household purposes, 231

EARTH closets, 275; difficulty of keeping regularly clean, 79; management of, 76, 77; necessity for regular and compulsory supervision, 79; plans, etc., of, 43

Ebi-Bacthar (Arab author), 183

Ecclesiastical Commissioners, condition of property held by them, as bearing on the question of village health, 73

Education, as affecting village communities, 50–52

Education Department, 383, 385, 434

Electric lighting, benefit of, in comparison with gas, oil, or candles, 300; comparative table of gas and other lights with electric light, 302

Emerson, Ralph Waldo, quotation from, 305

Æolus roof-ventilator, 575

FACTORY Acts, 445–455, 459–463, 466, 467, 468, 472, 475, 476, 478, 479, 480, 481, 484, 489, 490, 492, 494, 495, 498, 502, 503, 505, 507, 509, 510, 512, 525, 529, 531, 537, 538

Factory legislation, history of (from 1802 to 1883), 445–464

Fenders, marble or glazed faïence, 356

Fever, causes of cottage, 27; how it is caused, 25; to what conditions mainly due, 309

Field, Mr. Rogers, 82

Field's flush tanks, 50

Filters, 238, 239

Fire-places, use of iron or wire guards, 116

Floors, varnishing and staining of, 310

Flush-tanks, 48, 281, 285, 333

Frankland, Dr., F.R.S., on the pollution of water from shallow wells, 259; statement by him, 262; remarkable case of typhoid fever poisoning at Lausen, Switzerland, 262

Fresh air, its effect on the organization of children, 110, 111

GALTON, Capt., quotation from, 324

Galton ventilating fire-place, 596

Gas, Cannel, 302
Gas, common, 302
Gas, its escape into houses, 177, 178; dangers which accrue from its escape, 179; method of testing for leakage described, 179, 180
Gasoline, 626
Glandular swelling, cause of, 119
Glazed tiles, use of, for basements, passages, pantries, and larders, 303
Grease-collection chamber, importance of regular cleansing, 211

HARDING'S ventilator, 559
Hardwaters, 239, 240
Haviland, Mr. A., 156
Health, its relation to the development, adaptation, and happiness of the human race, 89; prominence of comparative National Health in the biology of the future, 89; its alliance to comparative pathology, 89; its bibliography, 90
Health officers, 83; qualifications of, 83
'Healthy Furniture and Decoration,' preliminary remarks on, 291
Healthy Schools, importance of the subject, 371, 372; sites, 375, 376; water supply, 376; drainage, 376, 377; use of wood for floors, 377; cubic space, 377, 380, 383; ventilation, 379, 381, 382, 422–425; warming, 383, 384; thickness of the walls as affecting temperature of the rooms, 384; arrangements of school offices, 386–390; supply of natural light, 390–393; injurious effects of defective light, 393–399; investigations in reference thereto, 395, 396; myopia, 393, 397, 398; hypermetropia, 396, 397, 398; "test-types" for detection of imperfect sight in children, 397, 425; supply of artificial light, 398, 399; school-desks and benches, 399–405; injurious effects of their faulty arrangements, 401–405; playgrounds, 376, 405–407; physical exercise for perfect health is necessary as well for girls as for boys, 407; question of school dormitories in boarding-schools, in its sanitary and moral relations, 408–411; day-rooms—ventilation and cubic space, 411; baths, as a question of personal hygiene, 411–414; provision for infirmaries, or sanatoria, in boarding-schools, 414–421; use of slippers in public elementary and day schools advocated, 421, 422; school dietetics, 426–431; duration of school hours, 431–434; regulations for the control of contagious sickness, 434–439; concluding remarks, 439, 440
Healthy village life, general requirements for, 29
Hellyer, Mr. S. S., 208
Hopper ventilators, 540
Horwood (Great), Report on the village of, extract from, 23
Houghton, Mr. 208
Houses, unhealthiness of modern houses, 293, 294, 295, 296, 297, 298; healthy and unhealthy sites of, 153, 154; importance of geological formation upon which houses are erected, 155, 156, 157; classes of subsoil, 158; aspect and prospect of houses, 161, 162, 163, 164; aspect compass, 162; source of dampness in, 165, 166; underground ventilation of, 166, 167; dry-rot, 167; arrangements of, 168; want of commensurate air-spaces, 169, 170; faultily planned in respect to the position of sinks and water-closets, 171, 172; basement plan prepared by Mr. R. T. Blomfield, 172, 173; "inlets,'

and "outlets" of air, 173, 174, 175, 176; escape of smoke and gas in, 177, 178; dangers which accrue from escape of gas, 179; method of testing for leakage, 179, 180; draining of, 181–204; duties of an architect in reference to their construction, 241, 364, 365; duties of an intending occupant, 242, 243; necessity for an efficient system of inspection, 243; duties of landlord and tenant, 244; caution as to taking houses without competent examination, 245; legislation in regard to sanitary arrangements, 311; danger of running to extremes in carrying out especial theories and doctrines, 313; difference of opinion among sanitary professors, 314; objectionable use of sham constructive ornament, 315, 316, 317; treatment of wall surfaces, 317, 318, 319, 320; contrast and arrangement of colours, 318, 319, 320; wall-papers, 320, 321, 322; washable papers, 321; "hygienic" papers, 321; instance of the danger arising from the use of putrid size and paste, 322; internal fittings of, 364, 365; constructive fittings, 327–331, 333; ventilation, 331; smaller fittings of, 357, 359, 360, 361; constructional fittings or store-places for clothes, etc., 342; their construction and rebuilding on a general and uniform system, 308; furniture as part of the general design of internal constructive fittings of, 344; dressing-rooms, 344, 345; basements of, great importance of proper sanitary arrangement, 302, 303; the scullery, 303; use of glazed tiles, 303; pantries, 303; larders, 303; use of glazed bricks, 304
Howarth ventilator, 528
Humpidge, Mr., 623
Hypermetropia, 396, 397

INCLOSURES Acts, effect of, 17–19
Instincts, discipline of the, 122

JEFFREYS, Messrs. & Co., 363
Jennings, Messrs., 592
Jennings, Mr. T. (of Lambeth)
Joly, M. (Paris), fan devised by him, 579
Jones, Mr. Owen, quotation from, 319

KERR, Prof., 162
Kite's ventilators, 175

LADIES' Sanitary Association, publications by, 111
Lamb, J. M. & Co., 580
Lambert, Sir John, 82
Lands and landmarks, 17
Lavatories, arrangements of, 353
Lawes, Sir John, quoted in reference to village clubs, 55, 56
Leasehold tenure, 342; present bad system of, 307
Leather-papers, 363
Leblanc, M. F., 423
Letheby, Dr., 159, 458
Lévy, Michel, quotation from, 29
Lighting for domestic use, 615–639; development of light during incan-

descence, 615; Bunsen burner, 616; luminosity of petroleum, 617; gradations of improvement in artificial lighting, 617–619; Argand burner, 618; comparison of heating power of candles and gas, 619; colza oil and cannel gas, 619; mineral or hydrocarbon oils, 620; approximate cost of candles and oil light, 621; of candles and gas, 634, 635; hygienic conditions in the burning of gas, 621–623, 625, 630, 634; regulation of over-pressure, 622; Stott's Automatic Gas Governor, 622, 623; enrichment of gas by hydrocarbonaceous vapours, 624; use of solid naphthaline by means of the Albo-Carbon Light Company's apparatus, 624–626; table of results of experiments with flat-flame Albo-carbon burner, 625; apparatus for burning petroleum oil or gasoline, 626; methods devised for using ordinary coal-gas, 626; the sun burner, 627; the globe light, 627, 628; the Siemens regenerative gas-burner, 628, 629; the Grimston burner, 629, 630; photometric value of such burners, 631; the Clamond lamp, 631–633; use of reflectors, 635; the electric light, 635–639; the arc-light, 635, 636; the incandescent light, 636; application of electric lighting to detached houses, 637; batteries for electric power storage, 637; proposed arrangement by Mr. Reck for storing heat from the exhaust steam by employing it to heat a hot-water reservoir, 639; concluding remarks, 639, 640

"Lincrusta Walton," 363

Locock, Sir Charles, advice by, 101

Lowmarsh, a typical English village in the pre-sanitation period, sketch of, 7

Lowmarsh College, description of, 10

Lying-in-room, 142; aspect of, 144; primary importance of *perfect quiet*, 144; various essential precautions to be observed, 144, 145; temperature, 145; special directions for protection of the bed, 145, 146; qualities of a good nurse, 146; child bed fever, 147; use of antiseptics, 147, 148; arrangement of the washstand, 148

Mantle-pieces 353, 355, 356

Mentmore, earth closets at, 78, 79

Metropolitan Building Act, 293

Moral training, 122

Morin, General, 588, 596

Myopia, 393, 397, 398

Napier and Ettrick, Lord, 29

Neatness, habits of, 121

Nightingale, Miss Florence, 348; quotation from, 110

Northumberland, 68; cottage arrangements in, 69

Notter, Dr. Lane (Netley Hospital), 239

Nurseries, 347–352; desirability of a southern aspect, 105; use of iron or wire guards to fireplaces, 116; washing of children, 116, 117; all woollen hangings objectionable, 113; colour of ceilings and walls, 113; kinds of carpets specially suitable, 114; discipline of, 122; importance of a dry situation, 105; require air and light, 105; number of rooms, 105; importance of drainage, 105; and of ventilation, 105, 112; details of internal arrangements, carpets, fittings, etc., 108, 109; cubic space, 112, 113

OCCUPATION, as affecting village life, 52
Order, habits of, 121

PAGET, Mr. R. H., 41
Paraffine, 302
Parkes, Dr., 535, 543
"Patent Hygienic Papers," 321
Péclet, quotation from, 578
Peggs, Mr. Wallace, C.E., 190
Perambulators, consequences of their misuse, 119
Percy, Dr., 555
Pettenkofer, M., 423
Plaster-work, ornamental, 361, 362, 363
Powders, use of toilet, 116
Premature birth, means for preservation of vital heat, 118
Prestwich, Professor, F.R.S., quotation from, 256, 257 ; section from a series of geological sections of the Thames Basin, 253
Priestly, Mrs., 348
Progress, 80, 81 ; principles of, 63
Public Health Act (1875), 435 ; Amendment Act (1878), 41 ; (Ireland) Act, 1878, 435 ; Water Act (1878), stringent provisions of, 40, 41

RAINWATER pipes, 222–228 ; dangers accruing from their terminations being too near windows or skylights, 222, 223 ; frequently made to do improper duty, 223, 227, 228 ; other sources of danger where the pipes are of cast-iron, 225 ; necessity of their delivering in the open air, 225 ; provision against choking up of rain-water pipes, 226 ; utilization of rain-water, 228, 229 ; filtration for soft-water supply, 229, 230 ; system of heating soft-water for household purposes, 231
Rawlinson, Sir Robert, 160, 165
Reck, Mr. A. B. (Copenhagen), exhibitor of iron-stove, 600, 601, 602 ; proposed arrangement for storing heat from the exhaust steam, by employing it to heat a hot-water reservoir, 639
Recreation, as applicable to the condition of small farmers and farm labourers, 52–55
Redgrave, Alexander, C.B., H. M. Chief Inspector of factories, 471, 497, 512, 513 ; Mr. R., R. A., quotation from, 327
Refuse, removal of, 42 ; general arrangements for, 42–44
Report by Mr. J. E. White (1862), 457 ; of children's employment commission (1862), quotation from, 469 ; of the Public Health Amendments Bill Committee (1878), 44 ; on hospital accommodation for infectious diseases, 82
Richardson, Dr. B. W., F.R.S., 135, quotations from, 140, 141, 306, 308, 309, 311 ; in reference to cleanliness, 248
Rivers Pollution Commission, 275, 277
,, ,, Prevention Act (1876), 273, 274 ; practically inoperative, 274
Roberts' Rainwater Separator, 268, 269, 270
Rococo period, 343
Rood, Professor, quotations from, 320
Roscoe, Dr., 423

Rothamsted Allotment Club, rules and regulations of, 56–59

Royal Sanitary Commission (1871), appointment of local authorities, 82

Rural fever dens, 25

Ruskin, Mr., quotation from, 365

Russell, Dr., 209

ST. KILDA (in 1834), village of, 22

Sandringham, plans of cottages at, 65; description of labourers' dwellings at, 64–66

Sanitary Commission (1870), 28

,, Engineering and Ventilation Company, 559

"Sanitary Maxims," 125–127

Sanitation (Domestic), intention and object of, 311; where needed, and its application, 487–530

Schönheyder Sanitary Stove, 631

Scullery, the, 303

Sewage, disposal of, 272–286; its application to land, 276–281; conditions suitable for its distribution, 277, 280; sources of its putrefaction, 277, 278; straining chambers, 278, 279; flush tanks, 281; sub-irrigation, 281–283; arrangement adopted in the United States, 282; example of disposal by gravitation, 283–285; pumping, 285

Sewer, method of disconnecting house drain from, 47, 50

Sherringham valve or ventilator, 540, 576, 577

Sickness, care in, 60–62; arrangements for better treatment of the poor in country districts, 60–62

Sick-room, southern aspect preferable, 124; invaluable effect of sunshine, 124; instance of this, 124, internal fittings and arrangements of the, 128; isolated, if possible, 125; proper drainage of paramount importance, 125; quotations from Mr. Pridgin Teale in reference thereto, 125; great importance of *quiet*, 128, 129; quotation from Miss Yonge, 130; beds, 129, 131; stretcher on wheels, 131; feather-beds should be entirely banished, 131; moving a patient, 131; foot-board, 132; "self-ventilation," 132; pillows, 132; waterproof sheet, 133; best position for the bed, 133; "crumbs," 134; heavy clothes, 134; dangers to health from imperfectly dried feathers, 135; O'Brien's bed-ventilating tube, 135

Siemens regenerative gas-burner, 628, 629

Sinks, disconnection of, 47; waste-pipes from, 211; collection of grease in sinks, 209

Slop-closets, 221

Smith, Councillor, of Glasgow, 176

,, Dr. Angus, 237, 551

Smoke Abatement Committee, 588, 593, 594, 595, 596, 609, 610

Soil-pipes, 214; best material for, 215; ventilation of, 216; test for faulty condition, 215

Sperm oil, 302

Squire, Dr. W., quotations from, 105, 107, 108, 112, 115, 116, 117, 118, 119, 121, 122

Stallard, Dr., 540

Staverton, Ecclesiastical Commissioners' estate in the parish of, 73, 74

Stephen, Mrs. Leslie, quotation from, 132, 134
Store-places in houses, 342
Subsoil, classes of, 158; chemical tests for, 159; subsoil draining, 161
Sulphuric acid, its presence in London air, 554
Sunshine, effect upon children, 105; invaluable effect of it in the sick-room; 124
Sylvester, system of heated air from the basement, 603

Teale, Mr. Pridgin (Leeds), 125, 594
Teething, 118
Temperature, should be carefully regulated in the sick-room, 136; should be equable, 140; sudden changes of, 119; unhealthy effect on children by over-heating, 111; as regards the lying-in-room, 145
Textile manufacturers, association of, code of instructions, 480, 481
Thermometer, indispensable in children's room for prevention of illness, 120; position at head of bed, 140, 141
Thorneycroft, Col., 592
Thorverton, improvements in Ecclesiastical Commissioners' estate in the parish of, 74
Tidal valves, 160; example of plan of, 160
Tobin tube ventilator, 138, 528, 540
Topley, Mr. (of the Geological Survey), 155
Toys, their distribution among poor children in hospitals, 349
Training School, description of a, 13, 14
Traps, description of, 205–214
Treutler and Schwarz, Messrs. (Berlin), exhibitors of the "Aërophor," 579
Tring, system of earth closets at, 76
Tubercle, frequent cause of, 119
Turner, Mr. Ernest, as regards the plethora of works on sanitation, 217

Vallin, M., 322
Ventilation, 298, 299, 300, 324, 325; in factories, 495, 496, 497, of rooms, 312; in sick-rooms, 135, 136; in sick-rooms, method employed in Canada, 136; use of a "Tobin tube," 137; open fire, 137; position of head of sleeper, 137; in sleeping-rooms, 346, 347, and nurseries, 348, 349; as regards grease chambers, 210, 211; and soil-pipes, 216; as regards lying-in rooms, 143, 144; and warming, 551; purity of air, 551; presence of ammonia, 552; smoke, 553; presence of sulphuric acid in London air, 554; formation of fog, 555, 556, 557; methods of filtering air, 558, 559; Harding's ventilator, 559; method adopted by the Sanitary Engineering and Ventilation Company, 559; of the ventilation of the Maddison Avenue Theatre (New York), 559; of the Houses of Parliament, 560; arrangement of the Æolus Water Spray and Ventilating Company, 561, 612; presence of carbonic acid in the air, 562; point of saturation, 563; humidity of the air in its bearing on ventilation, 564, 565, 566; degree of purity or impurity of air, 567 diffusion of organic emanations in rooms, 568; size of rooms for adequate ventilation, 568, 569; movement of air, 569–580; Watson's ventilator 573, 574; Boyle's ventilator, 575, 610, 611; Sherringham ventilator, 576, 577; use of fans, 577–580; principle of action of rotary fan, 578

the "Aërophor," 579; warming of air, 580-615; production of heat, 581; gas for heating purposes, 582, 608; prevention of smoke, 583; radiant heat, 584, 585; methods of warming for domestic purposes, 585; open fireplaces, 585-596; stoves, 596-603; hot-water pipes, 603-606; steam-pipes, 606-608; gas heating apparatus, 608-613; ventilating fire-place, 590, 591; classification of grates experimented upon by the Smoke Abatement Committee, 593, 594; Reck's stove, 600-602; supply of warmed air from the basement, 603, 604; efficiency of hot water as a method of heating, 604-606; advantages of steam heating, 606-608; general results of experiments made by Mr. D. K. Clark on heating by gas, 609, 610; Schönheyder's Sanitary Stove, 612; use of a *calorifère*, 614;

Verity, Mr. (London), fan devised by him, 579

Vernon's Patent Noiseless China, 129

Village (the), its significance in the evolution of society, 88, 89; health arrangements for, how they may be successfully adapted, 66

Villages, various health conditions in, 20

Virchow, Professor (Berlin), 279, 395

WALL-PAPERS, 320, 321; washable papers, 321

Wall-surfaces, 345, 346, 347; of nurseries, 350, 351; use of "Lincrusta, Walton" for, 363

Wanklyn, Professor, in reference to filtration, 238

Water, conveyed to villages and cottages either artificially or by rivers and streams, 40; House of Commons' Report on (1876), 41

Water-closets, 275, 276; 216-221; the "pan" closet, 217; the deep "Hopper" closet, 218; "wash-out" closets, 218; "Jenning's" closet, 219; the "valve" closet for general use, 219; invention of a closet enclosure by Mr. T. Waller, 220, 221

Water supply, how effected, 39; law of, 41; general arrangements, 270-272; hydraulic rams and wind engines, 271, 272; horse-power and manual machinery, 272; quantity required, 247, 249, 266; parliamentary return of amount of water-supply to every urban sanitary district in England and Wales (1879), 247; question of waste as bearing on the supply of country houses, 247, 248; sources of supply, 249; rainfall, 249; its measurement, 250; average rainfall, 250, 251, 266; underground water, 251-254; springs 254, 255; wells and cesspools, 255-260; pollution of wells by cesspools, 257, 258, 259; shallow wells contaminated by surface soakage, 259; Norton or Abyssinian tube-wells, 260; contamination of deep wells, 260-263; remarkable case of typhoid fever poisoning at Lausen in Switzerland, quoted by Dr. Frankland, 262; effects of pumping, 263; form taken by depression in underground water, 263, 264, 265; rain-water from roofs, 265-270; method of calculating available supply of rain-water, 267; storage tanks, 267, 268; Roberts' Rain-Water Separator, 268; principle of its action, 268, 269, 270; danger of using leaden pipes and cisterns, 270

Watson's ventilator, 573

Well-water, 232

Wells, supply of water by, 40

Wigwam, Micmac Indian, 20, 21
"Winchester quart," for collecting water for analysis, 232
Woburn, cottage arrangements at, 67
Workshop, health in the, 445–464; utilization of old dwelling-houses for workshops a grave evil, 523; printing-offices, 525; bookbinding, 526; industries where females are employed in unsuitable places, 527; ventilation of workshops, 531–545; causes which led to extension of legislative restrictions, 445, 446; diseases and mortality consequent on employment in certain trades, 456–459, 462; regulations as to bakehouses, 463, 529, 530; textile and cotton factories, 491–493; magnitude of the trade, 493; worsted and woollen mills, 493; flax mills, 493; preparation of tow, 494; of jute, 495; pottery making, 498–502; lucifer-matches, 502; fustian-cutting, 503, 504; metal trades, 505; injurious trades, 510, 511; white-lead manufacture, 511; type-founding, 513; chemical manure, 514; mercurial silvering, 514; cardboard enamelling, 515, 516, 517; cardboard bronzing, 517; paper-colouring, 518

"YARDLAND," meaning of the term, 18

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
STAMFORD STREET AND CHARING CROSS.

A

DESCRIPTIVE CATALOGUE

OF THE

OFFICIAL HANDBOOKS,

CONFERENCE PAPERS, LECTURES, ETC.,

ISSUED BY THE EXECUTIVE COUNCIL

OF THE

INTERNATIONAL HEALTH EXHIBITION,

1884.

"The authors have been carefully selected, and the information conveyed is generally both useful and trustworthy."—*Times.*

"Among the actual results of the opening of the Health Exhibition, not the least important is the issue of a series of Official Handbooks that practically illustrate the science of health in all its manifold aspects........The general excellence of the first instalment of these handbooks promises well for the value and completeness of the series; while the price at which they are issued, should assure the success they merit."—*Saturday Review.*

LONDON:
WILLIAM CLOWES AND SONS, LIMITED,
Official Printers and Publishers to the Executive Council,
13 CHARING CROSS, S.W.

Demy 4to. Illuminated Cloth, gilt edges, 10*s.* 6*d.*

The Changes and Development of Civil Costume in England.

From the Conquest to the Regency. With 24 Full Page Coloured Illustrations. By the Hon. LEWIS WINGFIELD.

This Work forms a most elegant and suitable gift as a souvenir of the Health Exhibition.

A LIST

OF THE

OFFICIAL PUBLICATIONS

ISSUED BY THE EXECUTIVE COUNCIL

OF THE

INTERNATIONAL HEALTH EXHIBITION.

WM. CLOWES & SONS, LIMITED, 13 Charing Cross, London, S.W.

OFFICIAL HANDBOOKS.

Health in the Village.

By Sir HENRY W. DYKE ACLAND, K.C.B., M.D., D.C.L., F.R.S., etc., etc. *Illustrated.* Second Edition. Price 1*s.*

Describes graphically an English Village in the 'Presanitation' period, and the misery of the people. It then states the ESSENTIALS OF HEALTH in an Agricultural Village; Dwellings; Water Supply; Removal of Refuse; Education; Occupation; Recreation; and Care in Sickness. It gives illustrations from the properties of large Landowners, and compares Past and Present. There are 50 Woodcut Illustrations.

Healthy Nurseries and Bedrooms, including the Lying-in Room.

By MRS. GLADSTONE. Price 1*s.*

This book attempts to bring before the public the chief points in connection with the subject it deals with, in a popular form. Relying for scientific facts on thoroughly trustworthy authorities, the authoress has endeavoured to clothe them in language which will appeal especially to wives and mothers, while giving such exact descriptions and directions as shall enable the suggestions to be carried out by an ordinary reader.

Healthy and Unhealthy Houses in Town and Country.

By WM. EASSIE, C.E., F.L.S., etc. With an Appendix upon the Water Supply and Discharge of Sewage for Country Houses. By ROGERS FIELD, B.A., M.I.C.E. *Illustrated.* Second Edition. Price 1*s.*

The body of the Handbook deals with healthy and faulty sites for houses; the arrangement of houses as regards general convenience; proper and improper drainage; with details of all kinds of sanitary equipments for a house from basement to attic; ordinary water supply and flushing of drains, and instructions to householders, etc., in town and country. The Appendix treats upon the secretion of, and the supply of, water for country houses, and for methods of disposing of the sewage.

Healthy Schools.

By Charles E. Paget. Price 1*s.*

Refers to general considerations of site; building and planning; ventilation; lighting and warming; arrangement of offices; and regulation of desks and seats in schools of all kinds. Deals with the special diseases apt to arise from neglect of such considerations, and points to the great advantages of good playgrounds; reviews the questions of feeding, school-hours, and the controlling of infectious illnesses.

Healthy Furniture and Decoration.

By Robert W. Edis, F.S.A. *Illustrated.* 2nd Edition. Price 1*s.*

Preliminary Remarks—Unhealthiness of Wooden Houses—Ventilation and constructive decoration—Healthiness of electric lighting in comparison with gas, oil lamps, and candles—Present bad system of leasehold tenure—Diseases attributable to badly built and filled houses—Sanitary decoration—Healthy treatment of floor and wall surfaces—Influence of colour on the optic nerves—Paper hangings—Washable papers—Unhealthiness of stuff hangings—Constructive fittings—Arrangement of different rooms—Healthy treatment of walls and fittings.—Bedrooms and Nurseries—Lavatories—Mantel-pieces—Smaller fittings of the house—Ornamental plaster-work—Leather papers, etc., for wall covering—Conclusion.

Health in the Workshop.

By James B. Lakeman, Esq. Price 1*s.*

CONTENTS.

Part I.—Progress of Factory Legislation from First Act in 1802 to Last Act in 1883—Causes which led to each extension—Diseases and mortality consequent on employment in certain trades—Successful efforts to free children from ignorance and oppressed toil—Improvement in physical vigour and development.

Part II.—Accidents: their causes and extent—where most frequent—why under more stringent regulations not reduced in number nor severity. Dangerous Machinery—how fenced—Cleaning machinery when in motion—Advice to operatives.

Part III.—Sanitation: where most neglected—Effect of employment in noxious trades—Unconverted dwellings used as workshops prejudicial to health—Industries where females are employed in unsuitable work—Degeneracy and deformity of operatives—Gradual restoration to former condition of sturdiness—Deficiency of closet accommodation, and appliances.

Part IV.—Ventilation: neglect of general defect in structural arrangement of workshops—Temperature—Overcrowding—Artificial warming—Mechanical ventilation—Diffusion of air—Examples of modes of ordinary ventilation.

Manual of Heating, Lighting, and Ventilation.

By Captain Douglas Galton, C.B., F.R.S. *Illustrated.* Second Edition. Price 1*s.*

Ventilation and Warming combined: Purity of Air; Movement of Air; Warming of Air. Town air is impure from Organic Matter and Smoke—Methods for diminishing impurity, providing pure air, and removing vitiated air in houses are shown—Heating by open fires, warm air, hot water, steampipes, and gas explained. Light arises from incandesence—Vitiation of air by lighting is explained.

Diet in Relation to Health and Work.

By Alexander Wynter Blyth, M.R.C.S., F.C.S., &c. Price 1*s.*

Division I.: First Principles—Food and Work. *Division II.:* Food Equivalents—Divisions of Food—Digestibility of Food. *Division III.:* Flesh and Milk. *Division IV.:* Chief Sources of the Carbohydrates. *Division V.:* Leguminous Vegetables—Fruits. *Division VI.:* Tea, Coffee, Cocoa, and Chocolate. *Division VII.:* The Principles of Diet—Diet in relation to Work—Diet in Development—Diet in Mental Exertion—Diet to reduce Fat—Diets to make Fat.

On the Principles of Cooking.

By Sept. Berdmore. Price 1*s.*

Introduction—Elements—Utensils—Verbs which illustrate Principles—Choice and Preservation of Meats—To Roast—To Bake—To Grill—To Fry—To Boil—To Simmer—To Stew (Soups)—To Stew (Sauces)—To Braise—To Baste—To Brown and Clarify—To Flavour—To Serve—Pastry—Kickshaws, or Hors d'Œuvre—Salads—Conclusion.

Food and Cookery for Infants and Invalids.

By Catherine Jane Wood. With an Introductory Chapter by W. B. Cheadle, M.D. Price 1*s.*

Food: Its uses in the economy of nature—Component parts—Relative proportions. Infants: The mistakes in feeding; quantity, time and manner—The results of those mistakes—In Growth—In Physique—In After Life—Rational Feeding and its great importance. Invalids: From what Cause—How affected by Food—Diseases whose aggravation or cure is affected by Food—Characteristics of Sick Dietary—Cookery.

Alcoholic Drinks.

By John L. W. Thudichum, M.D., F.R.C.P. Price 1*s.*

Wines of France, Germany, Austria and Hungary, Spain, Portugal, Atlantic Islands, Italy, Greece, Cyprus, The Crimea, Asia, Africa, America and Australia; British or Domestic Wines; Beer; Distilled Spirits; Liqueurs.

Water and Water-Supplies; and Unfermented Beverages.

By John Attfield, Ph.D., F.R.S., etc. Price 1*s.*

This Handbook includes a very full account of the sources, natural properties, qualities, etc., of all descriptions of water, "the basis of all beverages"; treats of the water-supplies of the city and the country; and embraces the preparation, purity, wholesomeness, etc. of aërated drinks, tea, other "teas," coffee, cocoa, and chocolate. A chapter on milk is added.

Salt; and other Condiments.

By J. J. Manley, M.A. Price 1*s.*

History of their Use in Ancient and Modern Times—Traditions, Customs, Superstitions, Associations connected with—Sources of Supply—Opinions, Ancient and Modern, as to Dietetic value, and Hygienic and Medicinal properties.

Legal Obligations in Relation to the Dwellings of the Poor.

By Harry Duff, M.A. With a Preface by Arthur Cohen, Esq., Q.C., M.P. Price 1*s.*

A summary of the law at present available for the prevention of overcrowding; the removal of nuisances; the demolition and reconstruction of unhealthy houses; showing the persons upon whom such obligations rest, and the manner in which they ought to be discharged, both in the metropolis and other parts of England.

Our Duty in Relation to Health.

By G. V. Poore, M.D., F.R.C.P. Price 1*s.*

This book is intended to show that each individual is morally responsible to himself and his neighbours in the matter of health; that national health depends upon the health of individuals; that health largely depends upon personal thrift and economy, and that without the intellligent assistance of individuals public authorities can do little. "Our Duty" is discussed in Five Chapters, *The House, Water, Air, The Right Use of Refuse,* and *Burial.*

Laboratory Guide to Public Health Investigation.

By W. Watson Cheyne, F.R.C.S.; and W. H. Corfield, M.D., M.A., F.R.C.P. *Illustrated.* Price 1*s.*

The work done in this laboratory deals with the life history of the minute fungi and bacteria, more especially with those which are parasitic on plants and animals. The study of fermentations is also included. The cause of the various communicable disease is the chief matter of study, as well as the study of the means required for destroying the virus, of interfering with its growth, or of converting it into a useful vaccine material.

Physiology of Digestion and the Digestive Organs.

By Arthur Gamgee, F.R.S. Illustrated. Price 1*s.*

Fermentation.

By Dr. Duclaux. With a Preface by M. Louis Pasteur. Price 1*s.*

The object of this book is the general study of ferments. It deals successively with their functions in the world, their influence on health and disease, their various modes of nutrition, their analogy with the constituent cells in the bodies of the higher animals, and the description of their contest with these cells.

Infectious Diseases and their Prevention.

By Shirley F. Murphy, M.R.C.P. Price 1*s.*

Infectious diseases cannot be prevented unless their nature is understood.—Reasons for believing that they are caused by the growth in the body of living organisms.—Circumstances under which these may be introduced into the body, and the means for preventing such introduction.—Methods of rendering the body proof against infection. —Destruction of infection.—General precautions.

Cleansing Streets and Ways in the Metropolis and large Cities.

By William Booth Scott, M.Inst.C.E. Price 1*s.*

London Water Supply.

By Colonel Sir Francis Bolton, C.E. Price 1*s.*

CONTENTS.

General Introduction—Notes on Water Supply.—Water Filtration.—System of the London Water Supply: 1. Rivers, Springs, and Wells; 2. The Metropolitan Water Companies; 3. The Sources of Supply.—The Water Examiner.—Statistics of Supply.

History and Description of the London Water Works—The Kent Water Works: On certain Well Waters in the Chalk District.—The New River.—The East London Water Works.—The Southwark and Vauxhall Water Works.—The West Middlesex Water Works.—The Grand Junction Water Works.—The Lambeth Water Works.—The Chelsea Water Works.

Appendix—Memorandum.—Rates of Supply.—Statutory Powers as to Dividends.

The Exhibition of 1884.

Fires and Fire Brigades.

By Captain Eyre M. Shaw, C.B. *Illustrated.* Price 1*s.*

Athletics; or, Physical Exercise and Recreation.

Part I. By the Rev. EDWARD WARRE, M.A. *Illustrated.* Price 1*s.*

Athletics, or physical exercise in relation to health.—True view.—Greek and Roman.—Development in individual—child, boy, man.—Use and misuse.—Development of Athletics social.—History of, in England.—Public Schools, Universities.—Games.—Rowing.—Training necessary.—Other pastimes.—Drill.—Volunteers.—Exercise for children and elderly people.—Athletics in Board Schools.—Towns.—Working Classes.

Athletics. Part II.

Cricket, Football, Lawn Tennis, and Health. By the Hon. E. LYTTLETON, M.A., and GERARD F. COBB, M.A. Price 1*s.*

Introductory.—Games not really appreciated in England ; the small number who play.—The benefit of exercise considered medically.—Games fulfil the requisite conditions better than taking a walk.—Importance of healthy games for women.—Various difficulties considered : How to obviate them.—The example of Germany.—How a cricketer should live.—Mr. Gladstone on the importance of chewing food.

Dress, and its Relation to Health and Climate.

By E. W. GODWIN, F.S.A. *Illustrated.* Second Edition. Price 1*s.*

This Handbook traces the changing fashions in dress from B.C. 2000. As far as the limits of the work allow, the modes of each period are described ; with illustrations taken from contemporary sources. Many fashions are referred to climatic necessities or love of ornament ; in this, as in other arts, beauty and fitness being not always reached or ever quite forgotten.

Accidental Injuries: their Relief and Immediate Treatment.

How to Prevent Accidents becoming more Serious. By JAMES CANTLIE, M.A., M.B., F.R.C.S. *Illustrated.* Second Edition. Price 1*s.*

This Handbook is intended as a guide, in simple language, from which the public may learn how to render efficient aid at the moment of injury. Not only are wounds, bruises, and broken bones, events of every-day occurrence, but a number of minor ailments, which might be relieved by the knowledge of some simple common-sense rules, are taken into consideration, and dealt with in a popular and yet not in a superficial manner.

Ambulance Organization, Equipment, and Transport.

By Surgeon-Major E. J. H. EVATT, M.D., A.M.D. *Illustrated.* Second Edition. Price 1*s.*

This Handbook describes in a popular manner the system of Ambulance Organization at work in the army for the relief of the sick and wounded in war. It also describes municipal ambulance systems. It deals briefly with the Red Cross organizations, and the various civil ambulance associations. It then describes the various equipments used in ambulance aid, stretchers, mule carriages, ambulance waggons, railway sick transport, marine ambulance arrangements and beds, with a short chapter on ambulance tents.

Schools of Art; their History, Work, Aims and Influences.

By JOHN SPARKES, Esq. Price 1*s.*

CONTENTS : National Art Tendencies in the Past—Origin, Progress, and Development of Schools of Art—The Select Committee of 1835, 1849, and 1864—Formation of Schools of Design—Department of Practical Art—Department of Science and Art—Present Constitution and Objects of Schools of Art—Their Influence in Manufacturing Industries and National Taste, &c.

The Conference Papers and Lectures—the subjects of which are enumerated in the following pages—may also be obtained in a separate form uniform with the above Handbooks.

The following is the arrangement of the Handbooks, Conferences, and Lectures, as they will be published in Volumes :—

Price 7s. 6d. per Volume.

HEALTH IN THE DWELLING.

VOLUME I. (*Published.*)

HANDBOOKS.

HEALTH IN THE VILLAGE. By Sir Henry W. Dyke-Acland, K.C.B., D.C.L., M.D., F.R.S., &c. &c. *Illustrated.*

HEALTHY NURSERIES AND BEDROOMS, INCLUDING THE LYING-IN-ROOM. By Mrs. Gladstone.

HEALTHY AND UNHEALTHY HOUSES IN TOWN AND COUNTRY. By William Eassie, C.E., with an Appendix by Rogers Field, C.E. *Illustrated.*

HEALTHY FURNITURE AND DECORATION. By Robert W. Edis, F.S.A. *Illustrated.*

HEALTHY SCHOOLS. By Charles E. Paget, M.R.C.S.

HEALTH IN THE WORKSHOP. By James B. Lakeman, one of Her Majesty's Inspectors of Factories.

VENTILATION, WARMING, AND LIGHTING FOR DOMESTIC USE. By Captain Douglas Galton, C.B., F.R.S., &c. &c. *Illustrated.*

INDEX TO VOLUME.

VOLUME II. (*In the Press.*)

CONFERENCES.

MANSION HOUSE COUNCIL ON THE DWELLINGS OF THE POOR.—The Lord Mayor, President; John Hamer, Secretary. 3, Queen Victoria Street, E.C.

"The Population of London and its Migrations"—"The Treatment of the London Poor"—"Overcrowding"—"Suburban Dwellings and Cheap Railway Fares"—"On the Creation of a Building Fund"—"Some Difficulties of Sanitary Legislation in the Metropolis"—"Suggestions to the Royal Commissioners."

ROYAL INSTITUTE OF BRITISH ARCHITECTS. Ewan Christian, President; William H. White, Secretary. 9, Conduit Street, W.

"The General Subject of the Construction of Houses with regard to Sanitary Arrangements"—"The Sanitary Arrangement of Houses in London during the last 120 years"—"Drainage under Dwellings"—"The Impermeable Construction of Roofs, Walls, and Basement Floors, with a reference to Ventilation and Warming incidental thereto"—"The Construction of Chimneys"—"A Suggestion with regard to the Construction of Doors so as to afford opportunity of Escape from Fire; and another on an economical mode of Fireproof Construction, adapted in several instances in Public and Private Buildings"—"Sanitary Aspect of Internal Fittings and Decoration"—"The Hygienic value of Colour"—"Collection, Storage, Management, and Distribution of Water for Domestic Purposes."

SOCIAL SCIENCE ASSOCIATION.—Sir Richard Temple, Bart., G.C.S.I., C.I.E., President; J. L. Clifford-Smith, Secretary. 1, Adam Street, Adelphi, W.C.

"What conditions are essential for a Healthy Dwelling, whether in an urban or in a rural locality, and how far is it desirable that they should be rendered compulsory by legislation?"—"What, if any, restrictions in the interests of health should be enforced in connection with the employment of girls and women in Workshops and Factories?"—"Is it desirable that notification of Infectious Disease should be obligatory?"—"Is it desirable to legislate further respecting the duties of Medical Officers of Health?"

INDEX TO VOLUME.

VOLUME III. (*In the Press.*)

LECTURES.

HEALTHY HOUSES. By T. Pridgin Teale, F.R.C.S.

FOUL AIR IN HOUSES. By Professor W. H. Corfield, M.D.

HEALTHY FURNITURE. By Robert W. Edis, F.S.A.

DOMESTIC USE OF GAS. By Harold B. Dixon, M.A.

VENTILATION IN CONNECTION WITH WARMING AND LIGHTING. By Captain Douglas Galton, C.B., F.R.S.

SMOKE ABATEMENT. By Ernest Hart, M.R.C.S.

HEALTHY TOWN AND COUNTRY HOUSES. By W. Eassie, C.E.

HEALTH IN THE WORKSHOP. By James B. Lakeman, one of Her Majesty's Inspectors of Factories.

ANGLO-SAXON HOUSES. By Professor J. Frederick Hodgetts.

INDEX TO VOLUME.

Price 7s. 6d. per Volume.

HEALTH IN DIET.

VOLUME IV. (*In the Press.*)

HANDBOOKS.

PHYSIOLOGY OF DIGESTION AND THE DIGESTIVE ORGANS. By Professor Arthur Gamgee, M.D., F.R.S. *Illustrated.*

DIET IN RELATION TO HEALTH AND WORK. By Alfred Wynter Blyth, M.R.C.S, F.C.S. *Illustrated.*

ON THE PRINCIPLES OF COOKING. By Septimus Berdmore.

FOOD AND COOKERY FOR INFANTS AND INVALIDS. By Miss Wood; with a Preface by Robert B. Cheadle, M.D., F.R.C.P.

WATER AND WATER SUPPLIES; AND UNFERMENTED BEVERAGES. By Professor Attfield, Ph.D., F.R.S.

SALT AND OTHER CONDIMENTS. By John J. Manley, M.A.

ALCOHOLIC DRINKS. By John L. W. Thudichum, M.D., F.R.C.P.

INDEX TO VOLUME.

VOLUME V. (*In the Press.*)

CONFERENCES.

CENTRAL CHAMBER OF AGRICULTURE.—Henry Chaplin, M.P., President; Major P. G. Craigie, Secretary. 7, Arundel Street, Strand, W.C.

"The Sources of our Meat Supply."—"The Causes which have Checked the Development of our Home Production of Meat."—"Home-grown Meat Supply and the Increased Production of Home-grown Meat."—"The Means of Securing the Supply of Meat to largely-populated Centres."

INSTITUTE OF CHEMISTRY.—Professor William Odling, M.A., F.R.S., President; Charles E. Groves, F.C.S., Secretary. Somerset House Terrace, W.C.

"Food Adulteration and Analysis," with Appendix.

BRITISH BEE-KEEPERS' ASSOCIATION.—The Baroness Burdett-Coutts, President; Rev. H. R. Peile, M.A., Secretary. Royal Horticultural Gardens, S.W.

"Foul Brood and its Prevention."—"Adulteration of Honey."

INDEX TO VOLUME.

VOLUME VI. (*In the Press.*)

LECTURES.

THE DIGESTIVE FERMENTS AND CHEMICAL PROCESSES OF DIGESTION. By Professor Arthur Gamgee, M.D., F.R.S.

PRACTICAL DIETETICS. By Professor F. de Chaumont, M.D.

CHEMISTRY OF BREAD MAKING. By Professor Charles Graham, D.Sc.

SCIENCE OF COOKERY. By Mattieu W. Williams, F.C.S.

PURE MILK. By G. W. Wigner, F.I.C., F.C.S.

THE ENGLISH DAIRY. By Professor J. P. Sheldon, F.C.S.

THE DANISH DAIRY. By Alexander Mariboe.

DAIRY MANAGEMENT. By Miss Marian Smithard.

REARING OF HAND-FED INFANTS. By Edmund Owen, M.B., F.R.C.S

ÆSTHETIC USE OF WINE. By John L. W. Thudichum, M.D., F.R.C.P.

INDEX TO VOLUME.

Price 7s. 6d. per Volume.

HEALTH IN RELATION TO CIVIC LIFE.

VOLUME VII. (*In the Press.*)

HANDBOOKS.

"OUR DUTY" IN RELATION TO HEALTH. By George Vivian Poore, M.D., F.R.C.P.

INFECTIOUS DISEASE AND ITS PREVENTION. By Shirley F. Murphy, M.R.C.P.

ACCIDENTAL INJURIES: THEIR RELIEF AND IMMEDIATE TREATMENT. HOW TO PREVENT ACCIDENTS BECOMING MORE SERIOUS. By James Cantlie, M.A., M.B., F.R.C.S. *Illustrated.*

AMBULANCE: ORGANISATION, EQUIPMENT, AND TRANSPORT. By Surgeon-Major G. J. H. Evatt, M.D., A.M.D. *Illustrated.*

CLEANSING STREETS AND WAYS IN THE METROPOLIS AND LARGE CITIES. By William Booth Scott, M. Inst. C.E.

FIRES AND FIRE BRIGADES. By Captain Eyre M. Shaw, C.B. *Illustrated.*

LEGAL OBLIGATIONS IN RESPECT TO DWELLINGS OF THE POOR. By Harry Duff, M.A., Barrister-at-Law; with a Preface by Arthur Cohen, Q.C., M.P.

SCHOOLS OF ART. THEIR ORIGIN, HISTORY, WORK, AND INFLUENCE. By John Sparkes.

INDEX TO VOLUME

VOLUME VIII. (*In the Press.*)

CONFERENCES.

SOCIETY OF MEDICAL OFFICERS OF HEALTH.

Subject (combined): Domestic Sanitation in Metropolitan and Rural Districts. Industrial Diseases: Spread of Infectious Diseases. Notification of Infectious Diseases: Disposal of the Dead: Cremation.

SANITARY INSTITUTE OF GREAT BRITAIN.

PARKES MUSEUM OF HYGIENE.

1. Domestic Sanitary Arrangements of the Metropolitan Poor—1a. The Improvement of the Sanitary Arrangements of Metropolitan Houses.—2. Domestic Sanitation in Rural Districts. 2a. Sanitary Houses for the Working Classes in Urban Districts.—3. Industrial Diseases.—4. Spread of Infectious Diseases.—(*a*) Through the Agency of Milk.—(*b*) Through other agencies.—5. Notification of Infectious Diseases.—(*a*) Its Importance and its Difficulties.—5a. (*b*) The Right and the Duty of the State to enforce it.—6. Disposal of the Dead.—6a. Cremation.

ST. JOHN'S AMBULANCE ASSOCIATION.

On the Carriage and Removal of the Sick and Injured.—On the Ambulance Organisation of the Metropolis during Epidemics.

SOCIETY OF ARTS—Water Supply and Distribution.

SOURCES OF SUPPLY.—"On the Area of Chalk as a Source of Water Supply."—"Water Supply in its Influence on the Distribution of the Population."—"On a possible Increase of Underground Water Supply."—"Water from the Chalk."—"The Origin of Water Supplies."—"Water Supply to Villages and Rural Districts."—"Water Supply."—"Sources of Water Supply."

QUALITY OF WATER. FILTRATION AND SOFTENING.—"Water for Domestic Use."—"The Softening of Water."—"The Detection of Sewage Contamination by the Use of the Microscope, and the Purifying Action of Minute Animals and Plants."—"The Chemistry of Potable Water."—"On the Purification of Water on a large Scale."

METHODS OF DISTRIBUTION; MODES OF GIVING PRESSURE; HOUSE FITTINGS; DISCOVERY AND PREVENTION OF WASTE, &c., &c.—"Water Distribution and Dual Supply."—"Modes of Distribution, with some remarks on Dual Supply."—"Water Supply for Fire Extinction."—"Mode of Distribution of Water."

INDEX TO VOLUME.

VOLUME IX. (*In the Press.*)

LECTURES.

ETHICS OF THE SKIN. By Malcolm Morris, M.R.C.S.

AMBULANCE ORGANISATION IN WAR AND PEACE. By Dr. Evatt.

ANGLO-SAXON DRESS AND FOOD. By J. Fred. Hodgetts.

OUR DOMESTIC POISONS. By Henry Carr, M. Inst. C.E.

HISTORY AND RESULTS OF A DISPENSARY FOR SICK CHILDREN THREATENED WITH CHRONIC DISEASE. By Dr. Gilbert of Havre.

HEALTH WORK AND PLAY IN VILLAGE LIFE. By Sir Henry W. Dyke Acland, K.C.B.

STREET ACCIDENTS AND THEIR AMELIORATION. By James Cantlie, M.A., M.B., F.R C.S.

THRIFT IN ITS RELATION TO HEALTH; OR, THE RIGHT USE OF REFUSE. By George Vivian Poore, M.D., F.R.C.P.

THE PREVENTION OF CHOLERA. By Professor F. de Chaumont, M.D.

RECREATION. By G. D. Darbishire, M.D.

Price 7s. 6d. per Volume.

GENERAL HYGIENE.

VOLUME X. (*In the Press.*)

HANDBOOKS.

ATHLETICS, OR PHYSICAL EXERCISE AND RECREATION. Part I. By Rev. Edmund Warre, M.A. *Illustrated.*

ATHLETICS. Part II. By Hon. Edward Lyttelton, M.A., and Gerard F. Cobb, M.A.

DRESS AND ITS RELATION TO HEALTH AND CLIMATE. By E. W Godwin, F.S.A. *Illustrated.*

FERMENTATION. By Dr. Duclaux, Professor of Biological Chemistry at the Sorbonne. *Illustrated.*

PUBLIC HEALTH LABORATORY WORK. PART I. WITH CATALOGUE AS APPENDIX. By W. Watson Cheyne, F.R.C.S.

PUBLIC HEALTH LABORATORY WORK. PART II. By W. H. Corfield; M.A., M.D., F.R.C.P., and C. E. Cassal, F.I.C., F.C.S.

LONDON WATER SUPPLY. By Colonel Sir Francis Bolton, C.E.

VOLUME XI. (*In the Press.*)

CONFERENCES.

MEDICAL SOCIETY OF LONDON AND NATIONAL HEALTH SOCIETY.

Dietaries—Duties of School Managers in relation to Epidemics—Preventive Treatment of Epidemics in Public and High Schools—Grammar and High Schools, their Construction and Arrangement—School Dormitories—Effects of Posture in Schools—Gymnastics in Schools—Gymnastics *Feriencolonien*—The Health and Physical Development of Idiots as compared with mentally sound children.

ROYAL METEOROLOGICAL SOCIETY.

Some relations of Meteorological Phenomena to Health.—English Climatological Stations.—Cumulative Temperatures, &c., as shown on the Diagrams exhibited by the Meteorological Office in the International Health Exhibition.—Some occasional Winds and their Influence on Health.—The Equinoctial Gales—Do they occur in the British Isles?

ASSOCIATION FOR THE ORAL INSTRUCTION OF THE DEAF AND DUMB.—The Earl Granville, K.G., President; A. H. Moses, Esq., Hon. Secretary. Address: 11, Fitzroy Square, W. Subject: Oral Instruction of the Deaf and Dumb.

On the Oral Instruction of the Deaf and Dumb. On the Education of Incurably Deaf Children.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—ELECTRIC LIGHTING—MUNICIPAL AND DOMESTIC.

Electric Lighting in relation to Health.—Physiological bearing of Electricity in relation to Health.

EPIDEMIOLOGICAL SOCIETY OF LONDON.

Health in India—Change of Type in Epidemic Disease—Leprosy in India, and the best means of preventing its increase.

VOLUME XII. (*In the Press.*)

LECTURES.

PARASITES OF MEAT AND FOOD (TWO LECTURES). By T. Spencer Cobbold, M.D., F.R.S.

CANDLES. By Leopold Field.

HISTORY OF ENGLISH DRESS. By Hon. Lewis Wingfield.

TEXTILES GENERALLY. By William Morris.

CHILDREN'S DRESS. By Miss Ada S. Ballin.

OLD AND MODERN POISON LORE. By A. Wynter Blyth, M.R.C.S.

SOAP. By Charles F. Cross.

OFFICIAL CATALOGUE, GUIDE, ETC.

The Official Catalogue. Price 1s.

Contains a full list of the Vice-Presidents, Executive Council, General Committee, Jury Commissions, etc., etc., with all the necessary Memoranda for the Guidance of Exhibitors. A detailed List of Exhibitors and their Exhibits, elaborately classified, indexed, and arranged with a view to easy reference.

The Official Guide. Price 3d.

With Coloured Plan and Illustrations.

This Guide gives an accurate and concise account of the arrangement of the Buildings, and of the most noteworthy objects contained in them; pointing out the best and most expeditious way of making a complete tour through the Exhibition. It includes an excellent Coloured Plan, Coloured Pictures of the Old London Street and of the Grounds, an exhaustive Index and copious Marginal Notes to facilitate ready reference, and an Introduction setting forth the purport and general scheme of the Exhibition.

Daily Programme of Music, &c. Price 1d.

Contains all the arrangements for the day, including Meetings of the Conferences; Lectures, Lessons on Cookery, etc., in the Lecture Hall; Practices in the Gymnasium; Organ Recitals, Vocal and Instrumental Concerts in the Albert Hall; Programme of the Musical Selections performed in the grounds by the various Military Bands, &c., &c.

Recipes for Cheap Dinners. Price 3d.

These handy and very practical Recipes are prepared by Mrs. CHARLES CLARKE, the Lady Superintendent of the National Training School for Cookery, and are in daily use for the Cheap Dinners served in the Dining Rooms in connection with the School at the Health Exhibition. The work is prefaced by a chapter showing the object and work of the National Training School for Cookery, Summary of Rules, &c.

Handbook to the Aquarium. Price 6d.

Second Edition. Profusely Illustrated.

Contents :—Introduction.—History of the National Fish Culture Association.—Objects of the Association.—List of Officers.—Complimentary Lists.—Description of the Aquarium.—Description of the Fish Culture Department.—The Cultivation of Salmonidæ.—The Cultivation of Coarse Fishes.—The Acclimatisation of Foreign Food Fishes.—Hints on the Construction and Management of Fish Ponds.—Natural History of the Fishes exhibited in the Tanks.—List of Loan Exhibitors.

WILLIAM CLOWES & SONS, LIMITED,
OFFICIAL PRINTERS & PUBLISHERS TO THE EXECUTIVE COUNCIL,
13, CHARING CROSS, LONDON, S.W.

A
CATALOGUE
OF THE
OFFICIAL PUBLICATIONS
ISSUED BY THE EXECUTIVE COMMITTEE
OF THE
INTERNATIONAL FISHERIES EXHIBITION.

The exhaustive range comprised by the Handbooks and Prize Essays, which are by writers of great eminence and authority, and the comprehensive nature of the Papers which emanated from the various Conferences, combine to render this Series an exceptionally instructive and condensed Library of Reference on all questions appertaining to Fish, Fishing Appliances, and the Fishing Industries of all Countries, brought down to the date of the International Fisheries Exhibition of 1883.

LONDON:
WILLIAM CLOWES AND SONS, LIMITED,
OFFICIAL PRINTERS AND PUBLISHERS TO THE EXECUTIVE COMMITTEE,
13 CHARING CROSS, S.W.
1884.

A

CATALOGUE

OF THE

FISHERIES EXHIBITION LITERATURE

PUBLISHED BY

WM. CLOWES & SONS, LIMITED, 13, Charing Cross, S.W.

THE INTERNATIONAL FISHERIES EXHIBITION LITERATURE.

Complete in 14 Vols., each fully indexed. Demy 8vo. cloth. Price £6 6s.

The Fourteen Volumes, as above, comprise the whole of the IMPORTANT LITERARY OUTCOME of the Fisheries Exhibition, which is issued in a collected form with copious Indexes, &c., by desire of the Executive Committee.

Any of the various divisions of this work may be obtained separately, at the following prices :—

	£	s.	d.
THE HANDBOOKS. Forming VOLS. I. to III. ..	1	11	6
THE CONFERENCE PAPERS. Forming VOLS. IV. to VII.	2	2	0
THE PRIZE ESSAYS. Forming VOLS. VIII. to XI. ..	2	2	0
THE OFFICIAL CATALOGUE AND JURY AWARDS. } Forming VOL. XII. ..	0	10	6
THE OFFICIAL REPORT. Forming VOL. XIII. ..	0	10	6
THE ANALYTICAL INDEX. Forming VOL. XIV. ..	0	10	6

A Complete List, showing the contents of each of these volumes, will be found in the following pages, and single copies of any of the Handbooks, Conference Papers, or Prize Essays, may still be obtained of the Publishers at the prices affixed, although the volumes of each division *cannot be sold separately*.

THE FISHERIES LITERATURE—VOL. I.

HANDBOOKS—PART I.

CONTENTS :—

THE BRITISH FISH TRADE. By His Excellency Spencer Walpole, Lieut.-Governor of the Isle of Man. 1*s.*

MARINE AND FRESHWATER FISHES OF THE BRITISH ISLANDS. By W. Saville Kent, F.L.S., F.Z.S. 1*s.*

THE FISHERY LAWS. By Frederick Pollock, Barrister-at-Law, M.A., &c. 1*s.*

APPARATUS FOR FISHING. By E. W. H. Holdsworth, F.L.S., F.Z.S. 1*s.*

THE PLACE OF FISH IN A HARD-WORKING DIET, WITH NOTES ON THE USE OF FISH IN FORMER TIMES. By W. Stephen Mitchell, M.A. 1*s.*

A POPULAR HISTORY OF THE FISHERIES AND FISHERMEN OF ALL COUNTRIES FROM THE EARLIEST TIMES. By W. M. Adams, B.A. 1*s.*

THE FISHERIES LITERATURE—VOL. II.

HANDBOOKS—PART II.

CONTENTS :—

FISH CULTURE. By Francis Day, F.L.S., F.Z.S. 1*s.*

ZOOLOGY AND FOOD FISHES. By George Bond Howes. 1*s.*

THE UNAPPRECIATED FISHER FOLK: THEIR ROUND OF LIFE AND LABOUR. By James G. Bertram.

THE SALMON FISHERIES. By Charles E. Fryer. 1*s.*

ANGLING IN GREAT BRITAIN. By William Senior. 1*s.*

INDIAN FISH AND FISHING. By Francis Day, F.L.S., F.Z.S. 1*s.*

THE FISHERIES LITERATURE—VOL. III.

HANDBOOKS—PART III.

CONTENTS :—

FISHES OF FANCY: THEIR PLACE IN MYTH, FABLE, FAIRY-TALE, AND FOLK-LORE. With Notices of the Fishes of Legendary Art, Astronomy, and Heraldry. By Phil Robinson. 1*s.*

ANGLING CLUBS AND PRESERVATION SOCIETIES OF LONDON AND THE PROVINCES. By J. P. Wheeldon. 1*s.*

SEA FABLES EXPLAINED. By Henry Lee, F.L.S., F.G.S., F.Z.S. 1*s.*

SEA MONSTERS UNMASKED. By Henry Lee, F.L.S., F.G.S., F.Z.S. 1*s.*

PRACTICAL LESSONS IN THE GENTLE CRAFT. By J. P. Wheeldon. 1*s.*

LITERATURE OF SEA AND RIVER FISHING. By J. J. Manley, M.A. 1*s.*

THE FISHERIES LITERATURE—VOL. IV.

CONFERENCE PAPERS—PART I.

CONTENTS:—

INAUGURAL ADDRESS BY PROFESSOR HUXLEY, P.R.S. *6d.*

NOTES ON THE SEA FISHERIES AND FISHING POPULATION OF THE UNITED KINGDOM. By Vice-Admiral H.R.H. the Duke of Edinburgh, K.G. *1s.*

PRINCIPLES OF FISHERY LEGISLATION. By Right Hon. G. Shaw-Lefevre, M.P. *6d.*

FISH TRANSPORT AND FISH MARKETS. By His Excellency Spencer Walpole, Lieut.-Governor of the Isle of Man. *6d.*

THE ECONOMIC CONDITION OF FISHERMEN. By Professor Leone Levi, F.S.A., F.S.S., F.R.G.S., &c. *6d.*

A NATIONAL FISHERIES SOCIETY. By C. E. Fryer. *6d.*

RIVER POLLUTION BY REFUSE FROM MANUFACTORIES AND MINES; TOGETHER WITH SOME REMEDIES PROPOSED. By V. B. Barrington-Kennett, M.A., LL.M. *6d.*

PRACTICAL FISHERMEN'S CONGRESS. Under the Presidency of Mr. Edward Birkbeck, M.P. *6d.*

SCIENTIFIC RESULTS OF THE EXHIBITION. By E. Ray-Lankester, M.A., F.R.S., F.L.S., F.Z.S., &c. *6d.*

THE FISHERIES LITERATURE—VOL. V.

CONFERENCE PAPERS—PART II.

CONTENTS:—

FISHERY INDUSTRIES OF THE UNITED STATES. By Professor G. Brown Goode, M.A., &c. *6d.*

OYSTER CULTURE AND OYSTER FISHERIES IN THE NETHERLANDS. By Professor Hubrecht. *6d.*

THE FISHERIES OF CANADA. By Louis Z. Joncas. *6d.*

THE FISHERIES OF CHINA. By J. D. Duncan Campbell, Commissioner for China. *6d.*

A SKETCH OF THE FISHERIES OF JAPAN. By Narinori Okoshi, Member of the Japanese Consulate in London. *6d.*

NEWFOUNDLAND: ITS FISHERIES AND GENERAL RESOURCES. By the Hon. Sir Ambrose Shea, K.C.M.G., Commissioner for Newfoundland. *6d.*

THE SWEDISH FISHERIES. By Professor F. A. Smitt, Royal Commissioner for Sweden to the International Fisheries Exhibition. *6d.*

NOTES ON THE FISH SUPPLY OF NORWAY. By Frederik M. Wallem, Executive Commissioner for Norway to the International Fisheries Exhibition. *6d.*

NOTES ON THE FOOD FISHES AND EDIBLE MOLLUSCA OF NEW SOUTH WALES, ETC. By E. P. Ramsay, Commissioner for New South Wales. *6d.*

THE FISHERIES OF SPAIN. By Lieut.-Col. F. G. Solá, Executive Commissioner for Spain to the International Fisheries Exhibition. *6d.*

THE FISHERIES OF THE BAHAMAS. By Augustus J. Adderley, Commissioner for the Bahamas to the International Fisheries Exhibition. *6d.*

WEST AFRICAN FISHERIES, WITH PARTICULAR REFERENCE TO THE GOLD COAST COLONY. By Captain C. A. Moloney, C.M.G. *6d.*

THE FISHERIES LITERATURE—VOL. VI.

CONFERENCE PAPERS—PART III.

CONTENTS:—

FISH DISEASES. By Professor Huxley, P.R.S. 6*d.*

THE CULTURE OF SALMONIDÆ AND THE ACCLIMATIZATION OF FISH. By Sir James Ramsay Gibson Maitland, Bart. 6*d.*

THE HERRING FISHERIES OF SCOTLAND. By R. W. Duff, M.P. 6*d.*

MACKEREL AND PILCHARD FISHERIES. By Thomas Cornish. 6*d.*

SALMON AND SALMON FISHERIES. By D. M. Home, F.R.S.E. 6*d.*

COARSE FISH CULTURE. By R. B. Marston. 6*d.*

THE DESTRUCTION OF FISH AND OTHER AQUATIC ANIMALS BY INTERNAL PARASITES. By T. Spencer Cobbold, M.D., F.R.S., F.L.S. 6*d.*

THE FOOD OF FISHES. By Francis Day, F.L.S., F.Z.S. 6*d.*

MOLLUSCS, MUSSELS, WHELKS, ETC., USED FOR FOOD OR BAIT. By C. W. Harding, Assoc. M. Inst. C.E. 6*d.*

THE ARTIFICIAL CULTURE OF LOBSTERS. By W. Saville Kent, F.L.S., F.Z.S. 6*d.*

CRUSTACEANS. By Thomas Cornish. 6*d.*

THE FISHERIES LITERATURE—VOL. VII.

CONFERENCE PAPERS—PART IV.

CONTENTS:—

FISH AS FOOD. By Sir Henry Thompson, M.B., F.R.C.S., &c. 6*d.*

THE PRESERVATION OF FISH LIFE IN RIVERS BY THE EXCLUSION OF TOWN SEWAGE. By the Hon. W. F. B. Massey Mainwaring. 6*d.*

THE FISHERIES OF IRELAND. By J. C. Bloomfield. 6*d.*

IMPROVED FACILITIES FOR THE CAPTURE, ECONOMIC TRANSMISSION AND DISTRIBUTION OF SEA FISHES, &c. By R. F. Walsh. 6*d.*

SEAL FISHERIES. By Captain Temple. 6*d.*

STORM WARNINGS. By R. H. Scott, M.A., F.R.S. 6*d.*

SAVING LIFE AT SEA. By Richard Roper. 6*d.*

FISH PRESERVATION AND REFRIGERATION. By J. K. Kilbourn. 6*d.*

THE BASIS FOR LEGISLATION ON FISHERY QUESTIONS. By Lieut.-Col. F. G. Solá. 6*d.*

FOREST PROTECTION AND TREE CULTURE ON WATER FRONTAGES, ETC. By D. Howitz, Esq. 6*d.*

LINE FISHING. By C. M. Mundahl. 6*d.*

TRAWLING. By Alfred W. Ansell. 6*d.*

THE FISHERIES LITERATURE—VOL. VIII.

PRIZE ESSAYS—PART I.

CONTENTS:—

THE COMMERCIAL SEA FISHES OF GREAT BRITAIN. By F. Day, F.L.S., F.Z.S. 5*s.*

THE EFFECT OF THE EXISTING NATIONAL AND INTERNATIONAL LAWS FOR THE REGULATION AND PROTECTION OF DEEP SEA FISHERIES, ETC. By C. W. Morris. 3*s.*

SALMON LEGISLATION IN SCOTLAND, ETC. By J. M. Leith. 1*s.* 6*d.*

THE FISHERIES LITERATURE—VOL. IX.

PRIZE ESSAYS—PART II.

CONTENTS:—

IMPROVED FISHERY HARBOUR ACCOMMODATION FOR GREAT BRITAIN AND IRELAND. By J. C. Wilcocks. 2*s.*

THE BEST SYSTEM OF LIFE INSURANCE FOR FISHERMEN, ETC. By J. W. de Caux. 1*s.*

THE RELATIONS OF THE STATE WITH FISHERMEN AND FISHERIES, ETC. By C. E. Fryer. 1*s.* 6*d.*

THE RELATIONS OF THE STATE WITH FISHERMEN AND FISHERIES, ETC. By F. J. Talfourd Chater. 1*s.* 6*d.*

THE HISTORY OF DUTCH SEA FISHERIES, ETC. By A. Beaujon. 4*s.* 6*d.*

THE FISHERIES LITERATURE—VOL. X.

PRIZE ESSAYS—PART III.

CONTENTS:—

THE NATURAL HISTORY OF COMMERCIAL SEA FISHES OF GREAT BRITAIN AND IRELAND, ETC. By Rev. W. Houghton, M.A., F.L.S. 7*s.*

IMPROVED FACILITIES FOR THE CAPTURE, ECONOMIC TRANSMISSION, AND DISTRIBUTION OF SEA FISHES. By H. P. Blake. 1*s.* 6*d.*

A CENTRAL WHOLESALE FISH MARKET FOR LONDON. By J. J. Cayley and H. H. Bridgman, F.R.I.B.A. 5*s.*

THE BEST APPLIANCES AND METHODS OF BREAKING THE FORCE OF THE SEA AT THE ENTRANCE TO HARBOURS AND ELSEWHERE. By W. A. Smith. 1*s.*

THE FISHERIES LITERATURE—VOL. XI.

PRIZE ESSAYS—PART IV.

CONTENTS:—

THE PROPAGATION OF THE SALMONIDÆ. By J. Stirling. 1*s.*

THE PROPAGATION OF THE SALMONIDÆ. By T. Andrews. 1*s.*

THE PROPAGATION OF THE SALMONIDÆ. By W. Oldham Chambers. 1*s.*

THE SALMON DISEASE. By J. Clark. 1*s.*

THE SALMON DISEASE: ITS CAUSE AND PREVENTION. By W. A. Smith. 1*s.*

THE CULTIVATION OF FRESHWATER FISH OTHER THAN SALMONIDÆ. By R. B. Marston. 1*s.*

THE PROPAGATION OF FRESHWATER FISH, EXCLUDING SALMONIDÆ. By W. Oldham Chambers. 1*s.*

THE HERRING FISHERY. By R. Hogarth. 1*s.*

THE HERRING FISHERIES. By R. J. Munro. 1*s.*

THE HERRING FISHERIES. By H. J. Green. 1*s.*

THE SCOTCH EAST COAST, ORKNEY AND SHETLAND, LEWIS AND BARRA HERRING FISHING. By W. S. Miln. 1*s.* 6*d.*

THE NATURAL HISTORY AND CULTIVATION OF THE SOLE. By Rev. W. Houghton, M.A., F.L.S. 1*s.*

OYSTER CULTURE. By Commander C. V. Anson, R.N., and E. H. Willett, F.D.A. 2*s.* 6*d.*

OYSTER CULTURE. By Dr. P. P. Hoek. 1*s.*

THE BEST MEANS OF INCREASING THE SUPPLY OF MUSSELS AND OTHER MOLLUSCS, ETC. By T. F. R. Carr. 1*s.*

THE BEST MEANS OF INCREASING THE SUPPLY OF MUSSELS AND OTHER MOLLUSCS, ETC. By J. C. Wilcocks. 1*s.* 6*d.*

THE INTRODUCTION AND ACCLIMATIZATION OF FOREIGN FISH. By W. Oldham Chambers. 1*s.*

THE FOOD OF FISHES, ETC. By G. Sim. 1*s.* 6*d.*

THE CURRENTS, TEMPERATURES, AND OTHER PHYSICAL CONDITIONS OF THE SEA IN RELATION TO FISH. By W. Watt. 1*s.*

ANGLING CLUBS. By J. Skinner. 1*s.*

THE FISHERIES LITERATURE—VOL. XII.

CONTENTS:—

OFFICIAL CATALOGUE.

THE AWARDS OF THE INTERNATIONAL JURIES.

THE FISHERIES LITERATURE—VOL. XIII.

CONTENTS:—

OFFICIAL REPORT OF THE INTERNATIONAL FISHERIES EXHIBITION. By Spencer Walpole.

REPORT ON THE ELECTRIC LIGHTING. By William D. Gooch.

APPENDIX A. — CEREMONIAL AT OPENING OF INTERNATIONAL FISHERIES EXHIBITION AND ADDRESSES AT CLOSING.

APPENDIX B.—STATISTICAL TABLES. RETURN OF NUMBER OF VISITORS DURING THE TERM OF THE INTERNATIONAL FISHERIES EXHIBITION.

APPENDIX C.—DIGESTS PREPARED BY INVITATION OF THE EXECUTIVE COUNCIL AS TO THE CONDITION OF THE FISHING INDUSTRY IN THE UNITED KINGDOM AND ABROAD.

THE FISHERIES LITERATURE—VOL. XIV.

CONTENTS:—

ANALYTICAL INDEX TO THE WHOLE LITERATURE.

A Complete and Detailed List of the Literature published in connexion with THE INTERNATIONAL HEALTH EXHIBITION *post-free on application.*

WILLIAM CLOWES & SONS, LIMITED,
OFFICIAL PRINTERS AND PUBLISHERS TO THE EXECUTIVE COMMITTEE,
13, CHARING CROSS, S.W.